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CONTENTS.

EDITORIAL:
- Solar Energy 961
- The National Electric Light Association 962
- Broadening the Scope of the Central Station 963
- The Element Silicon 963

National Electric Light Association 964
New Features of Central-Station Service in Chicago 968
Some Physical Properties of Crystalline Silicon 977
Western Electric Reports Big Increase Over 1908 980
Electrical Exports for March 980
Testing of Transformers in Central Stations 981
A New System of Wireless Telegraphy Used by the Telefunken Company 986
The Design of Steam-Electric Power Plants 989
Why Laboratory Efficiency of a Light Source Differs from Efficiency of Illumination 992
Keep Up Their Equipment 993
The New Building of the Lotos Club, New York City 994
Editor of Power Acquitted on Libel Charge 997
Pennsylvania Tunnels to Be Completed Next January 997
Chicago Section Illuminating Engineering Society 998
The Story of a Successful Sign Campaign 1000
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 1002
INDUSTRIAL SECTION:
- A New Electric Flatiron 1004
- Sign Lighting with Tungsten Lamps 1004
- A New Electric Sign 1005
- Electric-Driven House Pump 1005
- Marshall Molding Receptacles 1005
- The Corcoran Wipe-Joint Machine 1005
- Babcock Electrics 1006
- Water Filtration for Steam-Boiler Users 1006
- The Harwood Electric Iron 1007
- New Form of High-Tension Crossing-Protector 1008
- Packard Tungsten Sign-Lamp Transformers 1009
- Reorganization of United States Light and Heating Company 1009
- Brookfield Glass Insulators 1010
- A Tungsten Turn-Down Lamp 1010
- The Portable "Positive" Electric Cleaner 1010
- Indirect Illumination 1011
- New Tools for Line Construction Work 1012
- The Latest G. E. Tungsten Sign Lamp 1012
- Starter for Motor-Driven Fire Pumps 1013
- The New Reco Flasher 1013

CURRENT ELECTRICAL NEWS 1014
RECORD OF ELECTRICAL PATENTS 1021

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SOLAR ENERGY.

One of the problems which has engaged the efforts of inventors is that of securing power from the sun's heat. A number of workers, realizing the intense heat energy in the focused rays from the sun and in the use of highly reflecting surfaces to concentrate the sun's rays at a central point, have looked to the construction of devices embodying the utilization of these principles for a successful solution of the problem of economic utilization of this form of heating. Ericsson, the Swedish inventor, devoted a large part of his active life to work upon this principle, and achieved some degree of success, but he finally gave it up in despair, announcing it as his belief that the materials of utilization were so costly that despite the fact that large amounts of heat could be absorbed, it could not be accomplished upon an economically efficient scale.

In 1898, a device which attracted a good deal of attention was the Pasadena solar motor; this was notable as being the largest of the mirror type of solar motors ever built. It was shaped like an inverted umbrella, covered with mirrored reflecting surfaces, which concentrated the heating rays and lighting rays from the sun upon a cylindrical water container or boiler. In connection with the heated water, ether or sulphur dioxide was pumped through pipes, and air engines especially constructed to operate upon the expansion of these low-boiling-point materials were used. This solar motor, however, was abandoned because of the intermittent supply of energy available, due to the changes which any variation of the weather would bring about.

This subject is most interestingly and exhaustively discussed in the *Engineering News* for May 13, where descriptions of the inventions of Frank Shuman, H. E. Willsie and John Boyle, Jr., are given. In the Shuman invention a tract of land is rolled level, forming a shallow trough. This is covered with asphaltum pitch and covered with about three inches of water. Over the water about one-sixteenth of an inch of paraffine is flowed, leaving between this and a glass cover about six inches of dead air space. It is estimated that a power plant of this type to cover a heat-absorption area of 160,000 square feet, or nearly four acres, would develop about 1,000 horsepower. In the Shuman system provision is made for storing hot water in excess of the requirements of a low-pressure turbine during the day, to be utilized for running the turbine during the period when there is no absorption of heat. Certain arrangements are made so that the circulation of the

heated water from the heat absorber to the storage tank and from the storage tank to the turbine through a condenser and back to the heat absorber is accomplished with very little expenditure of mechanical energy. The water enters the thermally insulated storage tank, or the turbine, as the conditions may demand, at about 202 degrees Fahrenheit. With a vacuum of twenty-eight inches in the condenser and turbine, the boiling point of the water is reduced to 102 degrees Fahrenheit; consequently when the hot water enters the turbine it contains 100 degrees more heat than it can hold, therefore as it reaches the nozzle of the turbine nearly ten per cent explodes into steam, lowering the temperature of the remainder of the water to 102 degrees. The steam and water strike the specially designed buckets as a homogeneous mixture having a velocity due to its expansion. The amount of water driven forward by the steam reduces the velocity after leaving the nozzle much below what it would be were there no water present, but the combined weight of the two is so much greater than the weight of pure steam that the power exerted on the blades is the same as though no water were present. Mr. Shuman assumes that a 1,000-horsepower plant built upon his plan would cost about $40,000, or $40 per horsepower.

The Willsie plant utilizes also the indirect system of absorbing solar heat and storing the hot water in tanks. This hot water is made to give up its heat by circulating it about a boiler containing some volatile liquid, and the vapor generated is used to operate the engine, is condensed, and returned to the boiler to be used again. Mr. Willsie gives a very interesting table of calculations comparing the cost per horsepower-hour in a 400-horsepower steam-electric and solar-electric power plant. On the basis of his calculations the steam plant would have to obtain its coal for sixty-six cents a ton to compete with the sun power plant in districts favorable to the latter.

Ericsson's experiments, which we believe were made between 1868 and 1875, failed, apparently, because of the lack of proper mechanical appliances to supplement the solar heat absorber, although the inventor's own air engine is today one of the most efficient of this type of machine yet devised. The Shuman plan considers the utilization of the direct absorption of heating and the indirect storing of heating energy in a thermally insulated storage tank, utilizing the steam and water directly in a low-pressure turbine. Willsie sticks to the same principle, but utilizes a volatile liquid as the expansion element. It is quite probable that the introduction of the low-pressure steam turbine, the utilization of which as a regenerative machine has been given close study for some time, and a compromise or combination of the mirror and the trough absorber, will put the sun power plant on even a better basis than either of these sanguine inventors has placed it. Certainly it is to be hoped that efforts in this direction will be crowned with success, and we may expect that in possibly a short time some of the arid regions may be made to bloom and the deserts of Arizona and Sahara may be the centers of considerable power developments.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

The thirty-second convention of the National Electric Light Association will be held at Atlantic City, June 1 to 4, inclusive. The committees in charge of the various arrangements have been working hard so that as many live active subjects as possible may be considered in the time available. The programme has been so arranged that on the first two days all matters of general interest will be presented, and on the last two days parallel sessions will be arranged so as to allow time for the presentation and discussion of papers relating to special branches of Association work. This will enable every person who attends the convention, irrespective of his position with the company with which he is connected, to take part in the discussion and to be benefited in the particular line in which he is most interested.

The analysis of the programme so far announced would appear to indicate that there will be ample time for the presentation of the papers and for some illuminating discussion on each subject. Many of the most prominent men in the industry have devoted considerable time to the preparation of papers and reports, and while it might be fair to say that their expositions bring out almost the last word on the various topics, it is necessary, in justice to the work that they have done, that if there is anything to add it should be presented on this occasion.

One of the features of the convention will be the Meter Committee's exhibit. So many requests have come to this committee for information regarding methods of installation and other features that it has been deemed advisable to supplement its report with an exhibit consisting of meter installations, meter connections for demonstrations of testing methods, meter testers' instruments, tools and appliances, shop and laboratory apparatus, and other data which have been secured in connection with the committee's work.

The report of the Lamp Committee will pay particular attention to the changes which have taken place in the lamp practice within the last two years, while the report of the gas-engine committee will be very complete. Attention will be given to the methods of producing gas, and operating results from installations in all sections of the country, working under all kinds of conditions, will be discussed. The Accounting Committee programme will be of particular value to those concerned with the financial arrangements of central-station companies, and the business getters plan a joyous carnival of food for thought at their sessions.

The committee in charge of exhibits of Class D members has been particularly active. The entire space available has been subscribed for, and it is expected that a number of entirely new machines and products will be exhibited at this important function of the convention. On another page of this issue a comprehensive summary of the exhibits to be shown and the list of those who will be in attendance representing the Class D members are given.

BROADENING THE SCOPE OF THE CENTRAL STATION.

In line with the centralizing tendencies of the times, there has been a most remarkable broadening of the central-station idea. Following the development of central waterworks and gas works, has come the extraordinary development of the electric central station. The evolution from its modest beginning as an arc-lighting plant in the eighties to its present commanding position has been most interesting and significant. After the addition of incandescent lighting there was a gradual development of motor load for all kinds of power applications. In recent years, along with marked improvements in the illuminating field, there has occurred the exploitation of electric heating and various other domestic uses of the current.

Throughout this period of development one has found in most communities a separate electric-lighting plant and a power house for the electric railway. The former supplied the central-station service referred to above and the latter supplied the current for the traction lines only. In a number of successful instances, where its charter permitted, the traction company has operated the electric-lighting and power business as an adjunct to its main industry, but in a comparatively small number of places has the central-station company had anything to do with traction business. That there may be most successful co-operation between these two great branches of the electrical industry, particularly where charter limitations prevent the direct engagement by one company in both railway and central-station business, is shown by the recent practice of the Commonwealth Edison Company of Chicago. As described in another article in this issue dealing with the features of central-station service in Chicago, probably the most striking development of the Commonwealth Edison Company's business in the past few years has been the acquisition of a great electric-railway load, so that at present there is connected with its system approximately 100,000 kilowatts of substation equipment for the current supplied to five Chicago traction companies.

This railway load, although originally acquired on account of the financial inability of the traction companies to build new power houses or extensions for the supply of current needed for the rapidly increasing traffic and the readiness of the central-station company to assume the load, has been maintained and increased beyond all expectations, notwithstanding the present ability of the two leading traction companies to raise all the money they may require. The secret of this lies in the exceptionally low rates charged for this service and the low fixed charges incumbent on the traction companies, due to the small investment needed for substation equipment as compared with what would be required for generating stations and transmission systems. On the part of the central station the railway load has been a most desirable acquisition in raising the load factor, particularly during the summer months. Moreover, the railway peak is not simultaneous with the lighting peak. The high economy attained by the Chicago central-station company in its generating stations, due to the high efficiency of the turbo-generators employed and the relatively low investment made possible by the use of steam turbines, has enabled it to make these exceptionally low rates on this class of service. These rates are less than what it would cost the traction companies to generate their own power. Although this development in Chicago has been on a scale far beyond the scope of the average central station, nevertheless there is scarcely any central station in this country that cannot learn from it the value of developing the railway load. There is no reason why there should be separate electric power stations for the railway and the lighting and power service. All these classes of service can be supplied excellently from one enlarged central station; in fact, the time has come when the scope of the electric central station has been broadened so that it exists for the supply of current for all branches of the electrical industry—lighting, power, traction, heating, telephone, telegraph, and for all applications where the electric current can be used.

THE ELEMENT SILICON.

In these days, when the conservation of natural resources has come to be considered seriously, a problem of increasing importance is to find energy sources and materials that have not yet been exploited and which at the same time are abundant in nature. As the coal supply diminishes, greater attention is being bestowed on waterpower and the power of the winds, waves and tides, as well as the solar energy directly available. As the timber supply becomes scant, the question of finding adequate substitutes attains as much importance as those of properly preserving the lumber in use and conserving the forests still standing. These tendencies provide an incentive to the scientists to investigate the resources in which nature abounds, and to point out such as seemingly may be adapted to the service of man.

Careful estimates have been made that the element silicon constitutes twenty-eight per cent of the earth's crust. It is found principally in form of silicon dioxide or silica, and this alone constitutes sixty per cent of the earth's crust. Aside from oxygen, no element is more abundant. In the form of silica or silicates, silicon forms an important constituent of sand, glass, cement and furnace linings. In its elemental form, however, it has received but little application. A stimulus in this direction may be found in the careful study of the physical properties of silicon made by the late Prof. Clarence I. Zimmerman, of the University of Wisconsin, presented at the recent meeting of the American Electrochemical Society, and which is abstracted at length in other pages of this issue. Among the most interesting and peculiar properties of this element are its electrical characteristics, particularly its resistance and rectifying power. The latter has been found of the greatest value in wireless telegraphy, as was shown in an article by G. W. Pickard in this journal on February 20, 1909. A study of Professor Zimmerman's paper may suggest other valuable uses for silicon.

The National Electric Light Association.

Thirty-second Convention, Atlantic City, N. J., June 1-4.—Exhibit of Class D Members.

Arrangements are about complete for the thirty-second convention of the National Electric Light Association, which will be held at Atlantic City, N. J., June 1, 2, 3 and 4.

A special rate of a fare-and-three-fifths, on the certificate plan, for the round trip has been authorized by the various traffic associations. The Electric Light Special will leave Chicago for Atlantic City Sunday, May 30, at 3 p. m., arriving early Monday afternoon, May 31. This train will run as a second section of the eighteen-hour flyer over the Pennsylvania Railroad, and will be under the supervision of J. J. Schayer. A special train will leave New York at 9:55 a. m. Monday, May 31, and a special train is being arranged from Boston.

The arrangements for the entertaining of those in attendance at the convention have been receiving the active attention of the entertainment committee.

For Monday night, arrangements have been made to have the pier given over for the exclusive use of the delegates and guests. The exhibition of Class D members will be formally opened at 8 o'clock. The reception will be held in the same hall at 9 o'clock, to be followed by dancing, at which light refreshments will be served on the balconies overlooking the ocean and the boardwalk.

For Wednesday afternoon the Inlet Baseball Park has been secured and a baseball game is scheduled between teams made up of members representing the East and the West.

On Thursday evening the large meeting room on the pier will be the scene of a unique entertainment. This feature has been designated a Café Chantant and a high-class musical and vaudeville entertainment will be produced.

The following programme has been announced:

Tuesday, 10 A. M.

First Session—President's address. Announcements. Report of Committee on Uniform Accounting; H. M. Edwards, chairman. Report of Committee on Progress; T. C. Martin. "Private Policy;" Paul Lüpke. Report of Question Box Committee. Report of Committee on State and Company Branches; R. M. Searle, chairman.

Tuesday, 8:30 P. M.

Second Session—Opening address. "Street and Park Lighting;" J. W. Cowles. "Methods of Manufacture of Incandescent Lamps, Carbon, Metallized, Tantalum and Tungsten, Showing by Samples Various Processes;" S. E. Doane. Illustrated lecture, "Quality of Light;" Paul Bauder.

Wednesday, 10 A. M.

Third Session—Manufacturers' Day.—"Advanced Information Regarding Developments in Storage Batteries;" Joseph Appleton. "The Regenerative Flame Lamp;" A. J. Mitchell. "The Present Status of the Arc Lamp for Street and Interior Illumination;" N. R. Birge. "Recent Types of Arc Lamps and Their Operation;" C. E. Stephens. Report of Committee on Meters—G. R. Green. "Future Requirements of Central Station Companies;" P. Torchio. "Some Recent Developments in Electrical Apparatus;" E. W. Allen. "Distributing Transformers as of Interest to Central Stations;" E. G. Reed.

Wednesday, 8:30 P. M.

Fourth Session—Executive.—Report of Treasurer; John F. Gilchrist. Report of Committee on Public Policy; Samuel Insull, chairman. Report of Lamp Committee; W. W. Freeman, chairman. Report of Insurance Expert; Wm. H. Blood, Jr. Appointment of Nominating Committee.

Thursday, 10 A. M.

Technical Session No. 1—Report of Committee on Gas Engines; J. B. Klumpp. "Some Features of Condenser and Cooling Tower Design and Operation;" M. R. Bump. "The Use of Reactance Coils in Generating Stations;" P. Junkersfeld. "Unique Features in Power Plant Design;" G. L. Knight. "Efficiency of Motor Generators and Synchronous Converters;" F. M. Farmer. "Transformers," W. A. Layman. "Low Pressure Steam Turbines;" C. H. Smoot.

Thursday, 2:30 P. M.

Technical Session No. 2—Report of Committee on Grounding Secondaries; W. H. Blood, Jr., chairman. Report of Committee on Protection from Lightning and Other Static Disturbances; B. E. Morrow, chairman. Report of Committee on Overhead Line Construction; Paul Spencer, chairman. "Recent Developments in Secondary Distribution Work;" W. K. Vanderpoel. "Requirements and Specifications for Extra High Potential Transmission Lines;" Arthur S. Ives. "Performance Specifications and Ratings;" W. L. Waters. "Central Stations in Towns of Less Than 4,000 Population;" J. S. Knowlson.

Commercial Programme, Thursday—A. M.

First Session—"Methods of Introducing Tungsten Lamps and Their Effect on Central Station Income;" W. H. Atkins, editor. "Practical Illuminating Engineering in Connection with a Commercial Department;" G. A. Sawin, editor. "Intensive Methods of Business Development;" John C. Parker. "Can a Display Room Be Conducted Upon a Profitable Basis?" Frank B. Rae, Jr., editor. "Advantages to Be Derived from Uniform Commercial Department Forms and Methods;" C. N. Stannard, editor.

Thursday—P. M.

Second Session—"Compilation of Load Factors;" E. W. Lloyd, editor. This paper to bring out the proper interpretation of the term "load factor." "Electric Power;" H. J. Gille, editor. "The Advantage of Group or Individual Drive in Certain Installations;" C. A. Graves, editor. "New York High-Pressure Fire System;" Arthur Williams. "Relation of Electric Vehicles to Central Stations;" J. T. Hutchings, editor. "Adoption of Electrical Heat for Industrial Purposes;" Charles J. Russell, editor.

Friday—A. M.

Third Session—"Electricity for National Advertising;" George Williams. Possibilities in standardizing bill-board lighting illustrated. Council of Progress. Executive session.

Friday—P. M.

Fourth Session—"Isolated Plants;" R. S. Orr, editor. Lighting. Power. Arguments successfully used. Experience of various companies. "Central Station Operation of Steam Plants in Connection with Central Station Service;" S. Morgan Bushnell, editor. "Novel Methods of Advertising in Small Towns;" Alex J. Campbell, editor. "The Development of Revenue from Existing Customers;" T. I. Jones, editor. "Electricity for Domestic Purposes;" M. E. Turner, editor. Installation. Domestic appliances. "Effect of Various Conditions of Maintenance on the Efficiency of Illumination;" A. L. Eustice, editor. Unfinished business.

Accounting Programme—Thursday A. M. and P. M. and Friday A. M.

"Depreciation;" G. E. Claflin. "Payrolls;" W. E. Freeman. "Cost Accounting;" H. R. Kern. "Supplies;" J. L. Bailey. "Branch Offices;" E. J. Allegaert.

Exhibits of Class D Members.

The exhibition of apparatus and material by Class D members bids fair to be one of the most extensive ever shown. The following representations have been scheduled:

A feature in connection with the Allis-Chalmers Company's exhibition is the provision made for representation by a staff of competent salesmen and engineers. This affords the visiting public an excellent opportunity of obtaining information on any problem involved in the use of the apparatus exhibited and of becoming acquainted with the company's products. C. A. Tupper will be in charge of the company's exhibit, as in former years, and will place on exhibition a sample board showing the construction of the blading of an Allis-Chalmers steam turbine. There will also be shown the well-known Type AL transformers, portable air compressor, mounted on an ordinary four-wheel platform truck; induction motor, Type "K" direct-current motor, and a rack containing views of Allis-Chalmers installations of prime movers. The company will be represented by: President W. H. Whiteside; M. C. Miller, assistant to the president; A. H. Whiteside, manager steam and electrical department; J. R. Jeffrey, assistant manager steam and electrical department; W. H. Powell, chief electrical engineer; and district managers, salesmen and engineers, including F. C. Randall, George Baiz, C. A. Burns, Harry Byrne, W. G. Clayton, J. T. Cunningham, H. W. Dennison, J. F. Dixon, A. N. Libby, W. C. MacEwen, A. P. Peck, A. F. Rolf, Geo. C. Dresser, W. O. Taylor, L. L. Willard, H. W. Rowley, E. T. Pardee, J. H. Waterman, St. John Chilton, J. B. Nicholson, S. H. Payne, H. H. Pease, E. I. Van Doren, J. C. M. Lucas, A. A. Hutchinson, J. L. Watson, J. F. Shipp, Seldon Jones, B Moore, O. C. Ross, J. W. Gardner and L. M. Harvey.

Adams-Bagnall Electric Company, Cleveland, J. G. Pomeroy, Chicago manager; G. A. Thompson, eastern sales manager; A. J. Mitchell, assistant sales manager.

Alberger Condenser Company, New York, L. R. Alberger, president; W. S. Doran.

American Electrical Heater Company,

Detroit, B. H. Scranton, president; Robert Kuhn, secretary.

The Anderson Carriage Company, Detroit, Mich., will exhibit its roadster type of car and also a four-passenger coupe. The company will be represented by Gordan D. Fairgrieve and E. W. Allen.

The American District Steam Company, Lockport, N. Y., will exhibit a model of its underground steam mains, showing various fittings, etc.; also condensation meters, live steam meters, both of the Holly and St. John type, and models of various steam specialties as manufactured exclusively by the company. It is also its intention to have detailed data on the operation of district steam heating systems in connection with electric light and power plants, also data on live steam plants. The company will be represented by Wm. H. Wells, president; H. J. Babcock, engineer; W. J. Kline, traveling representative; H. C. Kimbrough, manager western office; Robert Hall, treasurer; J. A. Bendure and Miss Rosemond Shankel.

The Baker Motor-Vehicle Company, Cleveland, Ohio, will exhibit a Baker Queen Victoria. On the outside there will be a runabout in service for demonstrating purposes. The company will be represented by Emil Gruenfeldt, chief engineer, Peter Dumont and O. B. Henderson, sales manager.

Bryan-Marsh Company, E. H. Haughton, Chicago manager; George G. Lockwood, New York manager.

Central Electric Company, Chicago, Geo. A. McKinlock, president; H. W. Young, sales manager.

Columbia Incandescent Lamp Company, St. Louis, C. Leonard, H. M. Cosh.

The Columbus Buggy Company, Columbus, Ohio, will exhibit two electric vehicles—Models 1001 and 1202. The company will be represented by R. S. Fend, superintendent electric department, and L. H. Estep, in charge of electric sales.

The Commercial Truck Company, Philadelphia, will exhibit a three-and-one-half-ton brewer's truck, which has just been completed for the American Brewing Company, of Philadelphia. This truck is equipped with a four-motor, four-wheel drive system, which is meeting with success in heavy haulage problems. A 1,000-pound electric delivery wagon, with spiral gear drive, one of which has been sold to the Philadelphia Electric Company for use in connection with delivery of its small household apparatus, will also be shown. The company will be represented by L. A. Tirrill, general manager; E. S. Hare, sales manager, and E. R. Whitney, chief engineer.

The Crocker-Wheeler Company, Ampere, N. J., transformers and generators, will exhibit a collection of photographs showing its various products, including direct-current motors, induction motors, power and lighting transformers, etc. Among the representatives of the company who will attend the convention are: R. N. C. Barnes, manager Boston district office; Rodman Gilder, secretary; R. J. Randolph, sales engineer.

Dale Company, New York, John Dale, president.

D. & W. Fuse Company, Providence, R. I., W. S. Sisson, secretary; H. F. MacGuyer. A full line of fuses and cut-outs, for low and high-tension circuits, samples of boxes for every service, Deltabeston magnet wire and an apparatus will be exhibited by the Pettingell-Andrews Company and the Western Electric Company.

The Dearborn Drug and Chemical Works, Chicago, chemists on the treatment of boiler waters, and manufacturers of high-class lubricants, will make its usual interesting exhibit. The company will be represented by Robert F. Carr, president; G. W. Spear, vice-president and eastern manager; H. G. McConnaughy, manager of New Jersey, and Paul T. Payne, manager Philadelphia office.

Dossert & Company, New York, will exhibit a number of improvements and new applications of special interest to central station and substation engineers, including elbows for connecting ingoing and outgoing solid buses through oil switches; lugs for connecting solid round to flat buses; special lugs for remote-control switches; special two-way studs for tapping from solid rods direct to buses and special studs for transformer connections. The company also expects to exhibit at Atlantic City for the first time the results of thorough and exhaustive tests of its devices now in progress at Cornell University. H. B. Logan, president, and H. S. Shope will be in attendance.

Doubleday-Hill Electric Company, Pittsburg, C. Phillips Hill.

The Duncan Electric Manufacturing Company, Lafayette, Ind., will have in operation integrating wattmeters, including graphic recording indicating instruments. The company has lately developed a portable rotating standard test meter, simple in construction, which will be shown operating in circuit with an ordinary service wattmeter, illustrating the use of the new meter. Another type of wattmeter new and novel in its application is the Duncan lamp comparison meter, showing at a glance the comparative consumption of ordinary metallic filament and tungsten lamps. New Model E astatic wattmeters, as well as switchboard and portable graphic recording indicating instruments, will form an interesting part of the Duncan exhibit. Several sizes of Duncan lighting and power transformers will be on exhibition. The company will be represented by Adrian Tobias, sales manager, and Wm. H. Sinks, salesman for the Central and Eastern States.

The Electric Storage Battery Company, Philadelphia, Pa., will exhibit various types of storage battery cells in which central station people are interested. For example, the largest cell in the world, consisting of 131 type "H" Exide plates, having a capacity of 22,000 ampere-hours, will be shown. This is one of the 150 cells recently contracted for by the New York Edison Company and makes the thirty-second battery installed in New York and Brooklyn. Alongside of this cell will be shown the smallest cell which the company makes, namely: a type "L-T," having a capacity of one-and-three-fifths ampere hours. The central station man is, or should be, intensely interested in increasing the use of electric automobiles, and the company, therefore, is making a large exhibit of the different types of Exide cells used for propelling electric vehicles and for ignition purposes. A large map showing the distributing system for Exide material throughout the United States indicates that approximately 600 centers have been established at which Exide material can be readily purchased by the owners of electric machines. Another interesting device is an exaggerated meter showing the current consumed by a vehicle motor on various grades. The company will be represented by Charles Blizard, third vice-president; Frank Stone, manager Boston office; R. B. Daggett, manager San Francisco office; G. H. Atkin, manager Chicago office; E. L. Reynolds, manager Pennsylvania sales office; H. B. Gay, manager Cleveland office; Albert Taylor, manager New York office; H. H. Seaman, manager Atlanta office, and H. L. Marshall, contract agent St. Louis office.

The Electric Suction Sweeper Company, New Berlin, Ohio, will exhibit two different sizes of the Hoover electric suction sweepers, namely, the twelve-inch size for use in the homes and the eighteen-inch machine, which is especially designed for commercial use. The sweepers are equipped with one-eighth and one-fourth horsepower motors, respectively, driving a rotary fan in connection with brush, similar to the kind used in carpet sweepers, combining the advantage of brush and suction, and in this way this cleaner is able to handle an amazingly large range of dirt. The company will be represented by W. H. Hoover and A. W. Wasey.

Electrical Testing Laboratories, New York, Dr. Clayton H. Sharp, F. M. Farmer, P. S. Millar.

The Fibre Conduit Company, Orangeburg, N. Y., will exhibit samples of its different types of conduit and fittings, and will be represented by F. A. Curtis and J. M. Nelson, Jr.

The Fort Wayne Electric Works, Fort Wayne, Ind., will exhibit the different forms of its single-phase meters, as well as its multiphase meters, also switchboard meters of the single-phase type. In this connection there will be shown two sizes of potential transformers; one size of current transformer used with switchboard wattmeters; one Type KM-1 calibrator, used for calibrating meters in service; a special meter testing board, arranged for testing of meters, so that every central station can be equipped to operate its own meters accurately; pedestal commutator truing devices, complete; Type A standard transformers; a number of small power motors of the various sizes from one-one-hundredth to one-sixth horsepower, in both alternating and direct current; larger type motors from three horsepower to five horsepower. A special device will also be exhibited, known as the "Compensarc," which is a special auto-transformer device for use with moving-picture machine arc lamps. A special switchboard for use in operating this compensarc so as to show relative comparisons will also be a part of this equipment. One each of the standard line of fan motors will also be shown. The company will be represented by F. S. Hunting, sales manager and treasurer; A. A. Serva, assistant sales manager and assistant secretary; J. C. Lott, manager New York office; T. L. Sturgeon, manager Philadelphia office; H. W. Smith, manager Boston office; C. A. Woolsey, agent, Philadelphia; E. H. Porter, engineer and salesman, Philadelphia; J. B. Mills, engineer; T. W. Behan, salesman, Philadelphia office.

Franklin Electric Manufacturing Company, Hartford, Conn., P. S. Klees.

Green Fuel Economizer Company, Matteawan, N. Y., A. H. Blackburn, general manager.

Gregory Electric Company, A. O. Kuehrnsted, vice-president.

The Habirshaw Wire Company, New York, will exhibit various samples of Habirshaw rubber-covered wires, and will be represented by J. B. Olson, secretary.

Jandus Electric Company, Cleveland, C. L. Eshleman, secretary; Louis J. Costa, manager Philadelphia office.

The H. W. Johns-Manville Company, New York, will exhibit a complete line of the new "Noark" fuse and service boxes, with interchangeable conduit fittings and entrance hoods. Two 13,200-volt fused switches designed for the protection of transmission lines will be exhibited for the first time. An interesting feature of the exhibit will be the "Noark" interchangeable service meter sealing system, which provides for the installation of any number of meters feeding from a single service, which in turn is protected by a "Noark" service box. The exhibit will also contain specimens of "Linolite" tubular lighting, both carbon and tungsten filaments, reflectors for show-window and showcase installations, picture lighting, weatherproof outlining material, and a va-

riety of well-made desk and table lamps, comprising a number of different finishes; Victor combination meters; porcelain high-voltage transmission insulators; asbestos wood for high voltage and transformer busbar and compartment protection; indurated fiber oil switch tanks; "Immovable" guy anchors; friction tapes and splicing compounds; high-tension strain insulators, and a variety of other fireproof and insulating materials of interest to central-station managers. The company will be represented by J. W. Perry, manager electrical department, New York; T. L. Barnes, assistant manager electrical department, New York; H. M. Frantz, manager electrical department, Chicago; Geo. A. Saylor, manager electrical department, Milwaukee; H. M. Voorhis, manager electrical department, Philadelphia; S. G. Meek, salesman electrical department, New York; Robert Charles Cole, electrical engineer, Johns-Pratt Company; R. C. Buell, assistant secretary, Johns-Pratt Company.

National Carbon Company, Cleveland, D. D. Dickey, general manager; A. M. Barron, factory manager; J. S. Crider, secretary; N. C. Cotabish, sales manager; J. F. Kerlin, assistant sales manager; A. E. Carrier, F. C. Park, C. W. Wilkins, M. W. Allen, W. T. Coun.

The Nernst Lamp Company, Pittsburg, will display a complete line of the new Westinghouse Nernst lamps. One of the latest developments of the Westinghouse-Nernst system which will be of considerable interest is the new spring type of holder, the design of which makes it applicable to lamps of the old type. This holder makes the mounting of glowers automatically correct, so that glowers may be renewed by common help not having the slightest experience in electrical work. This ingenious device will be worth inspecting. There will be exhibited, for the first time, the new single-glower lamp, the new universal cluster, ornamental multiple glower lamps and universal chandeliers of the Art Nouveau, Renaissance and Composite type. The company will be represented by W. D. Uptegraff, vice-president; Max Harris, general sales manager; Charles A. Barton, manager New York office; Garrett F. Hom, manager Philadelphia office; J. H. Gardiner, manager Boston office; J. B. Mitchell, manager Baltimore office; Otto Foell, chief engineer; A. L. Eustice, illuminating engineer; J. O. Little, manager of publicity department, and S. P. Wilbur of the engineering department.

New York & Ohio Company, Warren, Ohio, R. E. Gorton.

The Novelty Incandescent Lamp Company, Emporium, Pa., will exhibit a full line of carbon-filament, regular tungsten and any-position tungsten lamps. The company will be represented by R. K. Mickey, president.

Okonite Company, Chicago, W. L. Candee, president; Geo. T. Manson, general superintendent.

Otis Elevator Company, New York, R. W. Charles, assistant general sales manager; W. N. Dickinson, manager foreign department.

The Philadelphia Electrical and Manufacturing Company, Philadelphia, will exhibit a new and complete line of tungsten street-lighting fixtures, one of the especial features being a line of ornamental brackets, as well as hoods and casings, to be used with single lamps and clusters, so as to give them the appearance of being arc lamps instead of incandescents; a new type of absolute cut-out will also be shown, as well as fuse boxes, malleable line material of all kinds, the latter embracing many new and novel ideas never heretofore shown. The company will be represented by C. L. Bundy, secretary and treasurer, and W. O. Dale, salesman.

Phoenix Glass Company, New York, A. H. Patterson, vice-president; E. H. Peck.

The Pittsburg Transformer Company, Pittsburg, Pa., will exhibit a complete line of the new Pittsburg transformers, together with parts of the same. The new Pittsburg transformer has been tried out during the last year and a half and arrangements are now complete in regard to production in quantity of the entire line from 0.6 to fifty kilovolt-amperes. Attractive souvenirs have been prepared for distribution and the famous Pittsburg transformer stogie will also be in evidence. The company will be represented by F. C. Sutter, H. G. Steele, R. V. Bingay, P. H. Butler, C. R. Lininger.

The H. B. Camp Company, New York, will exhibit samples of its vitrified clay conduits and also some photographs of installations where this duct is used. The company will be represented by C. C. Baird, western sales representative, and R. P. Keasbey, eastern sales manager.

The Pettingell-Andrews Company and the Price-McKinlock Company, Boston, will have a joint exhibit. The Central Electric Company, Chicago, will also have its representatives at the Price-McKinlock Company booth. There will be shown a full line of P.-M. specialties, including the well-known devices for the protection and control of customers' services, the P.-M. remote-control switch, meter-connection blocks, O.-K. fuse-block covers, O.-K. ground clamps, and the new high-efficiency "Opalux" reflectors. The Pettingell-Andrews Company will also show D & W fuses, Okonite rubber-covered wire, O.-K. weatherproof wire, Wheeler street fixtures, Locke insulators, "Opalux" tungsten fixtures, "Opalux" reflectors, Macbeth glassware, Tungstometers and Peerless tungsten lamps, and the new Metropolitan seal. F. S. Price, secretary; W. J. Keenan, manager of sales, and G. E. Palmer, electrical engineer, will represent the Pettingell-Andrews Company.

The Ricker Manufacturing Company, Rochester, N. Y., will exhibit meter and service boxes, which are designed to prevent theft of current, also to enable the testing, or changing, of meters without interrupting the consumer's load; oil-fuse boxes, for alternating-current, high-voltage systems; cable junction box for direct-current distribution, underground; divided service box, for interior feeders, and acting as tie line. The company will be represented by George Hearn, president.

The Federal Electric Company, Chicago, Ill., will exhibit three samples showing its general types of signs and a small exhibit showing the various types of tungsten clusters which it is now making. The exhibition will also include a sample board of specialties and a small exhibit, illustrating the working of the "dim-a-lite" and a miniature model of a ground-plate installation and a vacuum cleaner. The company will be represented by James M. Gilchrist, general manager, and H. E. Brinckerhoff and J. J. Magee from the New York and Philadelphia offices of the Federal Sign System Electric.

The Sangamo Electric Company, Springfield, Ill., will exhibit Sangamo wattmeters, type "D" for direct current, and type "F" for alternating current; also as a special feature the new Sangamo ampere-hour meters for storage-battery work, for use on electric automobiles, electrically-lighted trains, etc. The company will be represented by R. C. Lanphier, secretary.

The Minerallac Electric Company, Chicago, will exhibit, a Chicago printing attachment in operation, a cable joint showing Minerallac methods of making a perfect joint on high-tension cable, samples of voltmeter switches, reverse-current relays, speed-limit devices, testing adapters, emergency outfits and electroscopes. The company will be represented by Frank Kinney.

The Standard Electric Accumulator Company, New York, will exhibit a battery of twenty-three cells on a rack which is turned out especially for elapse-time machines. Different sizes of cells from ten to 200 amperes will be exhibited to show how this product is manufactured; also sparkers and elements for electric vehicles. Cells will be formed and charged, on which parties interested may make some tests. The company will be represented by C. DeWaal, secretary and treasurer, and J. Joseph Shaughnessy, sales engineer.

Standard Paint Company, New York, J. G. Satlerthwait, manager Philadelphia office; Chas. E. Smith, manager paint and electrical department; H. E. Lavelle.

The Standard Underground Cable Company, Pittsburg, Pa., will exhibit samples of quite a number of the very complete line of lead-covered cable terminals for indoor and outdoor use; and cable-junction boxes for use in manholes with single conductor and multi-conductor lead-covered cable, a sample of the same type of junction boxes which the company has been furnishing quite extensively in Central and South America for use with steel tape-armored cable laid directly in the ground, instead of installed in the ordinary duct system, such as we use in this country. There will also be exhibited a number of interesting samples of special types of cable as well as sections of joints made with the special insulating tubes for the jointing of high-tension cables. The company will be represented by F. C. Cosby, Boston sales manager; J. R. Wiley, assistant manager New York office; C. J. Marsh, manager New York office; H. P. Kimball, New York office; T. E. Hughes, manager Philadelphia office; W. H. Marsh, assistant superintendent of construction, and Chas. W. Davis, general superintendent of construction.

The "Star-Flame" lamp, the invention of W. H. Gardiner of Henry L. Doherty & Company, will be introduced. The new unit gives remarkable illuminating results, a long series of tests made while the lamp was in actual commercial service showing, it is said, an efficiency in the lower hemisphere of about three candles per watt. The headquarters of the Star-Flame are at 74 Cortlandt Street, New York.

The Studebaker Company's exhibit will be devoted to a display of the pleasure and commercial vehicles manufactured by the Studebaker Company. In space 43 will be exhibited its latest model Victoria Phaeton, known as No. 17-A. The car at its normal speed is as fast as a proper regard for weight and mileage makes practicable. The shunt is sufficient to care for all traffic conditions that are likely to arise. It has considerably more than enough mileage to meet any conditions that an electric vehicle is called upon to meet. Nothing appears to be spared in the direction of comfort. In addition to this machine, the Studebaker Company offers a cheaper machine of comparatively low speed but ample mileage, from which the shunt is omitted altogether, and which, therefore, particularly meets the requirements of all those who do not wish to place in the hands of their families anything which can in any probability lead to accident. The running gear of this vehicle will be furnished with three body models—the Victoria Phaeton, Landaulet and Coupe. The motor in the new vehicle is of special type, with ample overload efficiency to take care of reasonable grades. The battery equipment consists of twenty-six cells of eleven-plate battery, so distributed between the front and rear of the vehicle as to equalize the weight. The normal running speed of the

vehicle will be sixteen miles an hour, with twenty miles an hour with the shunt, and the mileage will be approximately fifty to sixty miles, according to street surface and grade conditions. At space 53 will be exhibited a combination passenger and merchandise carrying vehicle, mounted on the commercial type running gear, designed for normal load service of from 1,500 pounds to 2,000 pounds. The body of this vehicle is equipped with removable seats, so that this type of machine may serve for electric-light companies, requiring emergency-service vehicles for the transfer of material or workmen; for mills and factories, located at a distance from railroad stations; for hotels as either a station or baggage vehicle; for summer resorts as a sight-seeing vehicle. The running gear of this machine is provided with forty-two-inch driving wheels, furnished with independent Westinghouse motors. The battery is suspended on supplementary springs within its compartment, thereby providing additional flexibility and minimizing the cost of maintenance. The lubrication is of the railroad waste-box type now usually adopted on street railways and considered to be absolutely reliable and requiring a minimum of attention.

The Tungstolier Company, Cleveland, will exhibit the folding tungstolier, a mechanical device showing the arms raising and lowering automatically. The company will be represented by E. J. Kulas, R. B. Basham, H. L. Parker, Milton Hartman.

The booth of the Engineering Department of the National Electric Lamp Association will show the various types of incandescent lamps manufactured by the member companies of the association. From a four-sided arch construction a dome is supported, completely outlined with small low-voltage tungsten sign lamps. Suspended from these arches are several types of tungsten regular Meridian type lamps, equipped with the latest forms of high-efficiency Holophane reflectors. The interior of the booth is furnished in a uniform style of woodwork adapted to the exhibition cases, tables and furniture. The separate exhibits show the processes of manufacture of tungsten lamps. The several sizes of street series and multiple lighting lamps with corresponding Holophane reflectors are exhibited on one rack, while the different sizes of multiple lamps are shown with a wattmeter connected. A large four-sided case contains an exhibition of all standard sizes of Gem, tantalum and tungsten lamps and many regular and special types of carbon, tantalum, tungsten miniature automobile and train-lighting lamps for several classes of service. P. F. Bauder, assisted by R. F. Strickland and G. S. Merrill, will be in charge of the exhibit.

The Wagner Electric Manufacturing Company, St. Louis, Mo., besides showing one of its well-known single-phase and one polyphase motors will exhibit an operating model of the Wagner single-phase motor centrifugal device. The device is so mounted with commutator, shaft and bearings, but without rotor or stator spider and windings, that by connecting it with another operating motor, its action can be observed. The Wagner delegation will include the following: F. N. Jewett, sales manager; W. A. Layman, vice-president and general manager; Walter Robbins, assistant general manager; E. W. Goldschmidt, New York manager; John Mustard, Philadelphia manager; Brooks Faxon, Boston manager; Dean Emerson, Cincinnati manager; E. H. Cheney, Chicago manager; Alfred Collyer, Montreal manager; Ray D. Lillibridge, advertising manager; J. A. Nelson, of the advertising department. There will be exhibited at this convention in the Wagner space for the first time a new and important scientific achievement, the Wagner "Moralometer," a direct-reading instrument indicating the morals of an individual. It is anticipated that considerable amusement will be afforded by the readings from this instrument of such of the visiting delegates as will submit to having their morals divulged.

The Western Electric Company will exhibit both alternating-current and direct-current motors; arc lamps of all types, including the Hawthorn flaming arc; fan motors, both alternating-current and direct-current, including desk, ceiling, oscillating, and telephone booth types; and a complete intercommunicating telephone system will be installed and in operation. Pole line material; American transformers; charging rheostats for automobiles; D. & W. fuses; Deltabeston wire, and Habirshaw wire will also be shown. The following will be in attendance: H. R. King, and C. A. S. Howlett, Chicago; O. D. Street, M. A. Oberlander, E. W. Rockafellow, F. M. Dusenberry, H. M. Post, New York; F. D. Killion, R. M. Morris, Pittsburg; J. R. Gordon, Atlanta.

Ansonia Electrical Company, Ansonia, Conn., W. J. Tonkin, assistant secretary.

Condit Electrical Manufacturing Company, Boston, S. B. Condit, president; C. C. Badeau, chief engineer.

Weston Electrical Instrument Company, Waverly Park, Newark, N. J., Caxton Brown, secretary; C. P. Frey, Philadelphia representative; F. E. Gilbert.

The large exhibition booth of the Westinghouse Electric and Manufacturing Company will occupy a central position, employing a decoration scheme of a pergola covered with grape-vines. The booth illumination will be carried out with various sizes and types of Westinghouse tungsten lamps, ranging from five to 250 watts, including the new five-watt, four-candlepower tungsten sign lamps. Series tungsten lamps for street lighting will be exhibited, with both the paper cut-out and adjuster-socket types of hanger receptacles. Forty, fifty and eighty-watt metallized-filament lamps will also be shown. The Cooper-Hewitt Electric Company will exhibit its latest mercury-arc lamps in this booth. Westinghouse mercury-rectifier sets will be shown for storage battery and other small direct-current work. Storage batteries and parts will be exhibited by the Westinghouse Machine Company. The motor display will include a full line of shunt and compound-wound direct-current, and single, two and three-phase alternating-current apparatus. A small motor-generator set will be used in demonstrating the operation of graphic recording meters, embracing a line of power, current, voltage, frequency and power-factor measuring instruments. Westinghouse portable and switchboard instruments, circuit-breakers, switches and choke-coils will also be exhibited. The display of electric conveniences will include electric sad-irons of various types, introducing the new, rounded, pressed-steel toe, tailor's goose irons, new electric toaster-stove, hot plate, glue and chocolate warmers, luminous and non-luminous electric radiators, sewing machine and fan motors, etc. The Westinghouse men present at the convention will be the following: Westinghouse Electric and Manufacturing Company—W. M. McFarland, acting vice-president; C. S. Cook, manager railway and lighting department; C. B. Humphrey, manager detail and supply department; G. G. Griffin, assistant manager detail and supply department; H. P. Davis, manager of engineering department; Geo. W. Bates, Charles Wahn, Boston; Samuel Chase, M. C. Rypinski, New York; W. P. Jend, W. B. Wilkinson, Pittsburg; John D. Mickle, Syracuse; W. Clegg, Jr., St. Louis; R. D. Nye, Cleveland; C. R. Gilliland, Cincinnati; J. W. Busch, W. P. Pinckard, Chicago; Lane Schofield, Baltimore; E. C. Means, Denver. Westinghouse Lamp Company—Walter Cary, general manager; T. G. Whaling, assistant general manager. Westinghouse Machine Company—E. H. Sniffin, sales manager; L. L. Brinsmade, Wm. G. Davis, New York; H. P. Childs, Philadelphia; H. H. Van Blarcom, Pittsburg; W. H. Worgorhorst, Cleveland; C. C. Chapelle, Chicago; D. C. Arlington, Pittsburg. Cooper-Hewitt Electric Company—Chas. B. Hill, vice-president; J. B. O'Shea, New York. Nernst Lamp Company—Max Harris, sales manager.

Other exhibitors who have arranged for space are Southern Exchange Company, C. J. Toersing Company, ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, *Electrical World*, John A. Roebling's Sons Company, C. W. Lee Company, Rauch & Lang Carriage Company, General Vehicle Company, General Electric Company, United States Lighting and Heating Company, Metropolitan Engineering Company, Popular Electricity Publishing Company, Duplex Metals Company, Economical Electric Lamp Company, Pittsburg Reinforcing Pole Company, American Electric Lamp Company, A. & J. M. Anderson Manufacturing Company, Fraley Hand Vibrator Company, *Electrical Record*, Griscom-Spencer Company, G. M. Gest, Waverly Company, Illuminating Engineering Publishing Company.

Public Service Telephone Company Asks for Space in Empire Subways.

The Public Service Telephone Company has filed an application with the Empire City Subway Company, New York city, controlled by the Bell interests, for space in its subways for telephone wires. The independent company claims the right to string wires in the subways under the franchise of the Longacre Light and Power Company, whose telephone rights it has taken over.

The officers of the company are: John M. Shaw, president; Clarence D. Simpson, vice-president; Joseph Hauck, treasurer; John A. L. Campbell, secretary; and Ronald R. Conklin, A. G. Wheeler, Jr., and Alfred J. Appel, directors.

President Shaw states that the company has made comprehensive plans to operate telephones in Greater New York; that it will probably use the automatic telephone and install eighteen exchanges, providing for 160,000 telephones.

The company's engineers are Duncan & Lindon. It is understood that the Public Service Company will increase its capitalization from $10,000,000 to $25,000,000 at once. Martin W. Littleton and George S. Graham are its counsel.

Philadelphia Section, American Institute of Electrical Engineers.

The Philadelphia Section, American Institute of Electrical Engineers, has arranged to hold the annual meeting in Atlantic City on Wednesday, June 2. The dinner will be at the Hotel Poinsettia, at 7 p. m. The courtesies of the N. E. L. A. have been extended to members.

New Features of Central-Station Service in Chicago.

The Distribution of Electricity in Bulk.

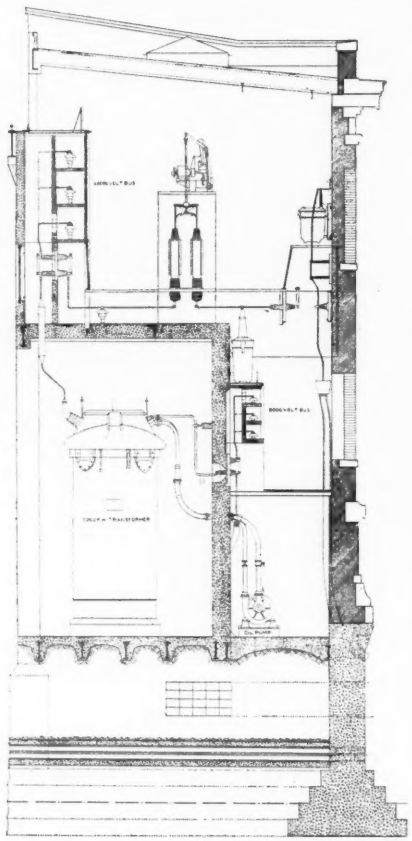
BY F. H. BERNHARD.

As typical of the best and most up-to-date practice in the central-station industry of our large cities, there is no system more worthy of study than that of the Commonwealth Edison Company of Chicago. The company's growth, policies, and its methods are so interesting that these have been closely watched, not only in this country but also abroad; in fact, the consideration of them had no little influence in shaping the recent consolidation of the electric power-producing companies of London. In the WESTERN ELECTRICIAN of May 16, 1908, appeared an extended article on the developments of the Commonwealth Edison system during the preceding five years. During the past year its new features have been so numerous as to be worthy of chronicling in this special article.

Aside from some very small companies and the Sanitary District of Chicago, which is supplying chiefly the municipal current requirements for street lighting, pumping, etc., of the city of Chicago and several smaller communities adjacent to it, from its hydroelectric plant at Lockport, the Commonwealth Edison Company is the exclusive central-station company of Chicago. Its retail distribution is confined within the city limits; its wholesale or bulk distribution to other public-service corporations, chiefly electric railways, while greatest within the city, extends also to its environs.

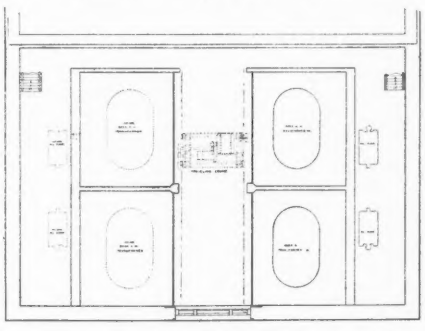
This outside distribution is accomplished through the harmonious co-operation between the Commonwealth Edison Company, the North Shore Electric Company and the Economy Light and Power Company. These three companies operate throughout the crescent-shaped zone, including Chicago and its suburbs, and extending from Milwaukee, Wis., some eighty-five miles north of the center of Chicago, to Kankakee, Ill., about fifty-six miles south of this point. At its greatest width this zone extends some eighteen miles west of Lake Michigan in the vicinity of Elmhurst. There is also an offshoot some thirty-five miles long from this zone in a southwesterly direction, connecting with the Economy Light and Power Company's system about Joliet, Ill.

This latter system comprises a hydroelectric plant developing 5,000 horsepower, and a new steam-turbine plant of 2,500 horsepower, both situated in Joliet. The company owns vast tracts of land



CROSS-SECTION OF WEST HALF OF TRANSFORMER HOUSE, FISK STREET STATION.

and riparian rights on the Desplaines, Kankakee, Dupage and Illinois rivers, which rights embrace two waterpower sites capable of developing 25,000 horse-



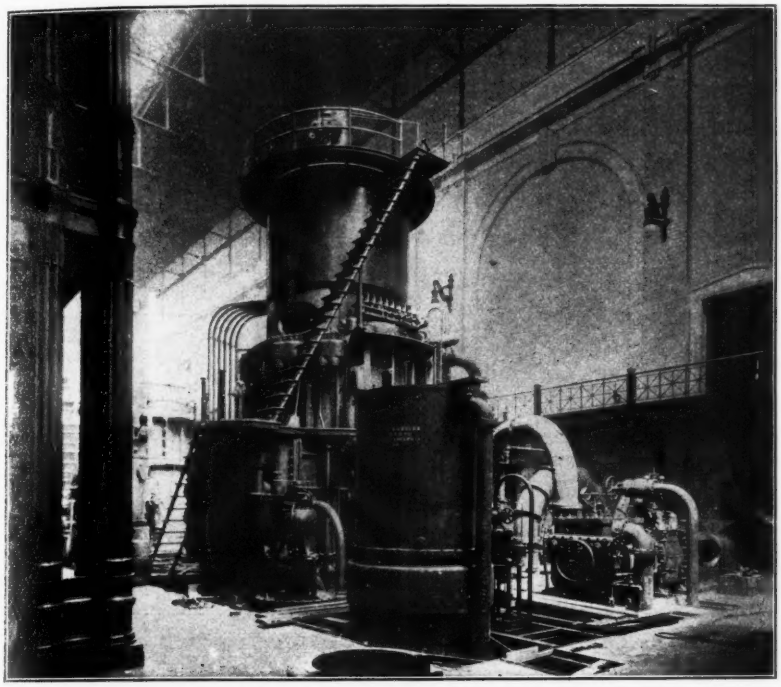
GENERAL PLAN OF TRANSFORMER HOUSE, FISK STREET STATION.

power. The electrical distribution in the city of Joliet and a number of its suburbs is operated from the system. The company also furnishes current for the operation of the electric cars in Joliet, and from that city to Chicago, also to Aurora and to Chicago Heights. This system is connected with that of the Commonwealth Edison Company by means of a 33,000-volt transmission line along the old Illinois and Michigan Canal. Over this line current bought from the Commonwealth company by the smaller company is supplied to Joliet and distributed there.

The North Shore Electric Company has four generating stations in the cities of Waukegan and Evanston to the north of Chicago, Maywood to the west, and at Blue Island to the south. In these plants are installed mostly steam turbo-generators having an aggregate capacity of about 10,000 kilowatts. The system of this company supplies current to the suburbs along the North Shore from Evanston to Zion City, also to the northwest and west of Chicago, and to the city of Blue Island and other suburbs to the south. There is also supplied about 2,000 kilowatts of energy for the operation of the Chicago and Milwaukee Electric Railroad and 2,000 kilowatts for the use of the Chicago Southern Traction Company, running from Chicago to Kankakee, Ill. The North Shore Electric Company's system is connected with that of the Commonwealth Company at Evanston and also at Blue Island by means of 20,000-volt underground cable lines.

In the system of the Commonwealth Edison Company proper there are three generating plants. Station No. 1 is at Harrison Street and the river. Its aggregate capacity is close to 20,000 kilowatts. No very radical changes have been made in this station for some time. It still operates some direct-current units, supplying the downtown district, as well as alternating current for the use of rotary-converter substations. The transition of this station into a steam-turbine station of much larger capacity is contemplated at some future time. Station No. 2, at Fisk Street, will have within a few weeks a capacity of practically 120,000 kilowatts. Station No. 3, at Quarry Street, will soon have a capacity of 42,000 kilowatts. This, with one smaller reserve plant, gives the company a generating capacity of approximately 185,000 kilo-

watts, nearly all obtained from steam turbo-generators.



THE NEW UNIT NO. 4, NEARLY COMPLETED, AT THE FISK STREET STATION.

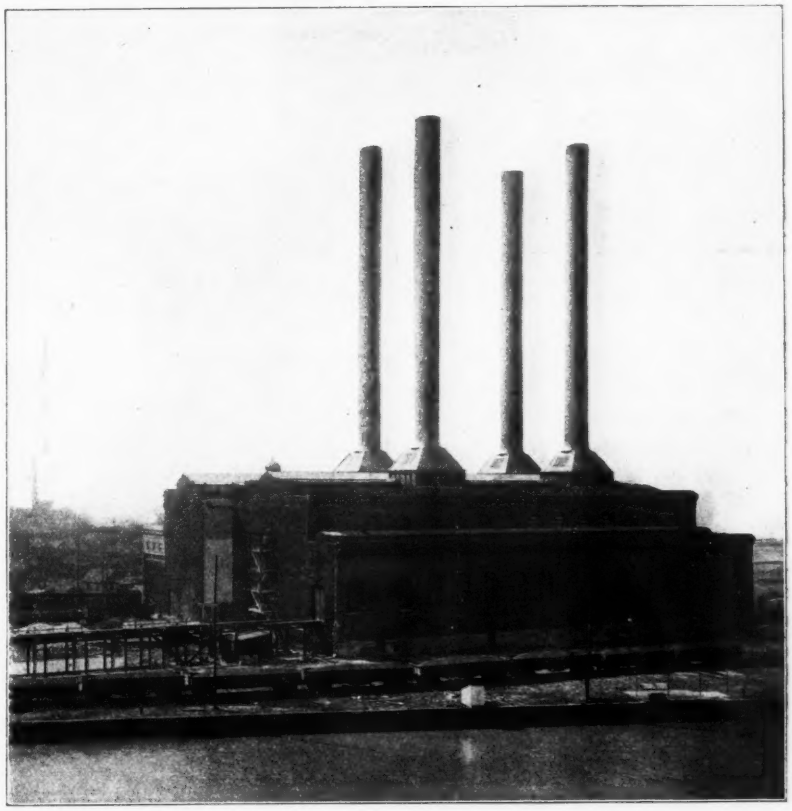
FISK STREET STATION.

To the reading public the general features of the station at Fisk Street and the Chicago River are familiar, since they have been described frequently in both technical and miscellaneous journals. To the power-plant engineer this station, although in operation less than six years, has achieved historic significance in showing the reliability and high economy of the steam turbine. It is not only the first central station where steam turbines were exclusively used for the generating units, but in it during one-and-a-half years the steam turbine received a wonderful development in efficiency and general serviceability.

The first four units installed were of 5,000-kilowatt rated capacity. By the development of the turbine-building art the last six, although not materially larger in bulk were of 8,000-kilowatt capacity on the old rating and very much more efficient in steam consumption. It has been found that these units, Nos. 5 to 10 inclusive, have on the new system of rating a maximum capacity in continuous operation of nearly 12,000 kilowatts each. Because of the lower steam consumption and of an improved arrangement of the grates and furnace chambers, the same sized boilers installed for the initial units have been found capable of supplying the larger turbines.

So important is it in central-station work to get the maximum efficiency and the largest possible output from the entire generating equipment that it was decided during the past year to dispose of the four original units and to install in their place duplicates of the larger ones that had been proven so economical and reliable. Early this year unit No. 4 was dismantled and in its place has been erected the new turbine, which, as shown in an accompanying illustration taken some ten days ago, is now ready to go into service. The work on the new No. 3 is pretty well along, and it is hoped to have it finished about June 5. In removing each of the old units its condensing equipment was disposed of as well and the other auxiliaries completely overhauled. When Nos. 1 and 2 are taken out and their substitutes erected the turbine room will have ten turbo-generators of uniform design and construction, thus giving it a still more imposing appearance than it has already possessed.

Coincident with the re-erection of the first four units there is being carried out the rebuilding of the furnaces for the boiler equipment corresponding to these units, and the installation of larger stokers. The stacks for these units are also being increased to a height of 260 feet, making all five of the stacks of the station uniform in this respect. To provide for the increased capacity in the new generators the cable and switching equipments of units Nos. 1 to 4 are being overhauled; the busbars are being changed



GENERAL VIEW OF QUARRY STREET STATION FROM THE FISK STREET BOILER HOUSE.

from the horizontal to the vertical arrangement employed in the rest of the switch house.

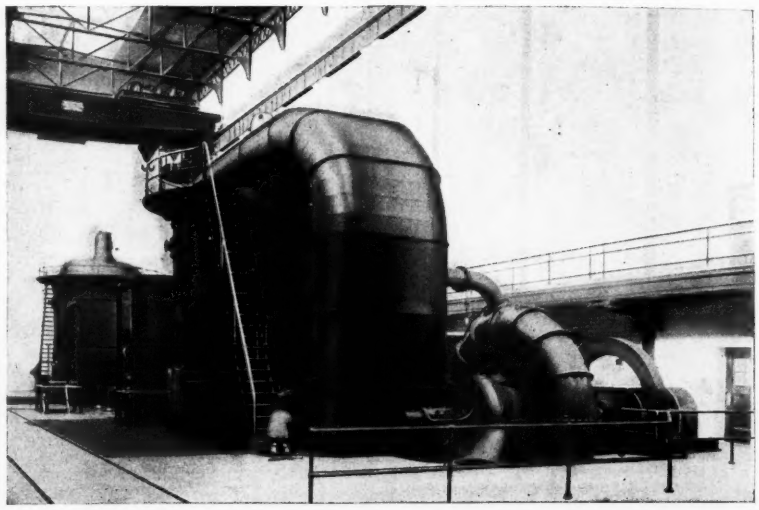
At the north end of the switch house provision has been made for four three-phase transformers stepping up from 9,000 to 20,000 volts. The second one of these new transformers is now being installed. As shown in the accompanying diagrams, each of these transformers is placed in a separate chamber. These transformers are of a new design, in which both the oil and the water are circulated for cooling, i. e., the oil is continuously circulated by a pump, besides the provision of coiled pipes through which the cooling water is passed from the house service. These special cooling devices were deemed advisable on account of the large capacity (5,000 kilowatts) and compactness of the transformers. The 20,000-volt underground cable lines from these transformers supply the two

COAL-UNLOADER IN QUARRY STREET TRAINSHED.

new high-tension ring systems running north and south from Station 2.

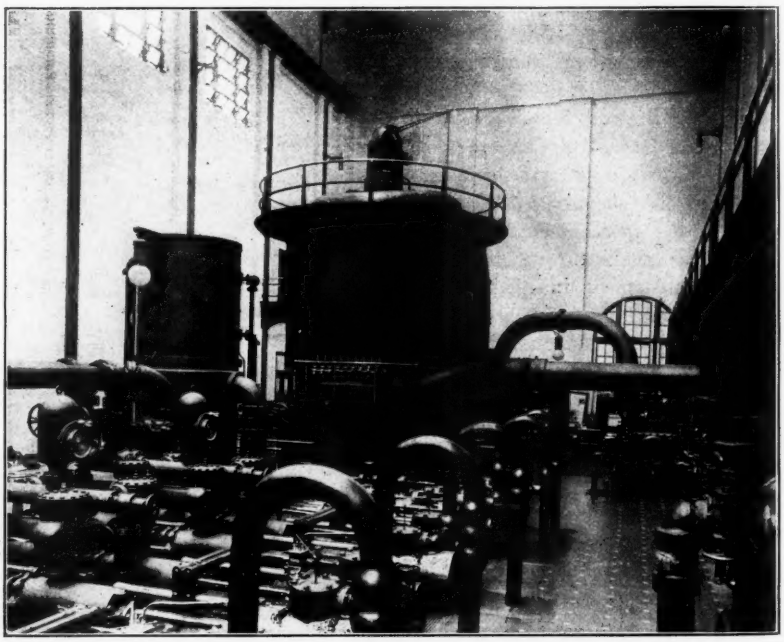
QUARRY STREET STATION.

The erection of another generating station on land secured at the south side of the river adjoining Quarry Street, opposite the Fisk Street plant, was begun a little more than one year ago. At the present time the first half-section of the Quarry Street station has been practically completed. The ultimate plans for this station contemplate the installation of six 14,000-kilowatt turbo-generators. As a means of raising the factor of safety of the system, it was deemed desirable to push the completion of the Quarry Street plant before adding the four additional units at Fisk Street to make the total of fourteen originally planned for. This and the rapidly-increasing load on the system accounts for the high rate of progress made in erecting the newest station. Unit No. 1 went into active service on October 17 last, just five years after the first Fisk Street unit began to operate; No. 2 was placed in operation November 28; No. 3 will probably be ready about June 15.



GENERAL VIEW OF UNITS NOS. 1 AND 2 IN THE QUARRY STREET TURBINE ROOM.

In the WESTERN ELECTRICIAN of May 16, 1908, the equipment and layout of the Quarry Street station was described with the aid of plans and a sectional elevation. No detailed description of this station will therefore be attempted here. A résumé of its general features, however, will not be out of place. The station runs in a general easterly and westerly direction on a rather long and narrow plot of ground. For this reason the comb arrangement of the boiler house used at Fisk Street was not adopted here, and the boiler room, therefore, is parallel with the turbine room and has a row of boilers on each side. The switch house adjoins the building on the south. As shown in the exterior view of the station, taken from the Fisk Street boiler house across the river, the arrangement of the four sections of the building makes a compact structure of the whole.



NEARER VIEW OF UNIT NO. 1 AND ITS AUXILIARIES, QUARRY STREET STATION.

Each of the turbine units has a battery of eight boilers set apart for it. There is a stack rising 250 feet above the boiler-room floor provided for each six boilers. This accounts for there being four stacks

for the three turbines now practically completed. An accompanying view shows the electric grab-bucket coal-unloader in use for emptying gondola-type coal cars. Bottom-dump cars feed directly into the track hopper. A complete coal-handling equipment is arranged to move the coal into the bunkers above the boilers expeditiously. The boilers are each designed to develop 35,000 pounds of steam at 225 pounds gauge pressure and 130 degrees superheat. The arrangement of the boilers, which are of Babcock & Wilcox make, is the reverse from that generally used in that the firing is done from below the lower instead of the higher ends of the tubes. In this way a longer and gradually enlarging combustion chamber is provided, resulting in a more complete combustion and greater furnace efficiency.

In the turbine room the arrangement is such as to place two units in a group with most of the auxiliaries between the turbines and the circulating pumps for the condensers on the outside. This arrangement is shown by the accompanying views. The turbines themselves, although said to be the most powerful prime movers ever built, do not seem to be as high as the ones used in the Fisk Street station; this is because the condensers are in the basement directly below the turbine-room floor, whereas each of the Fisk Street units has its condenser resting directly on the main floor and the turbine mounted above that.

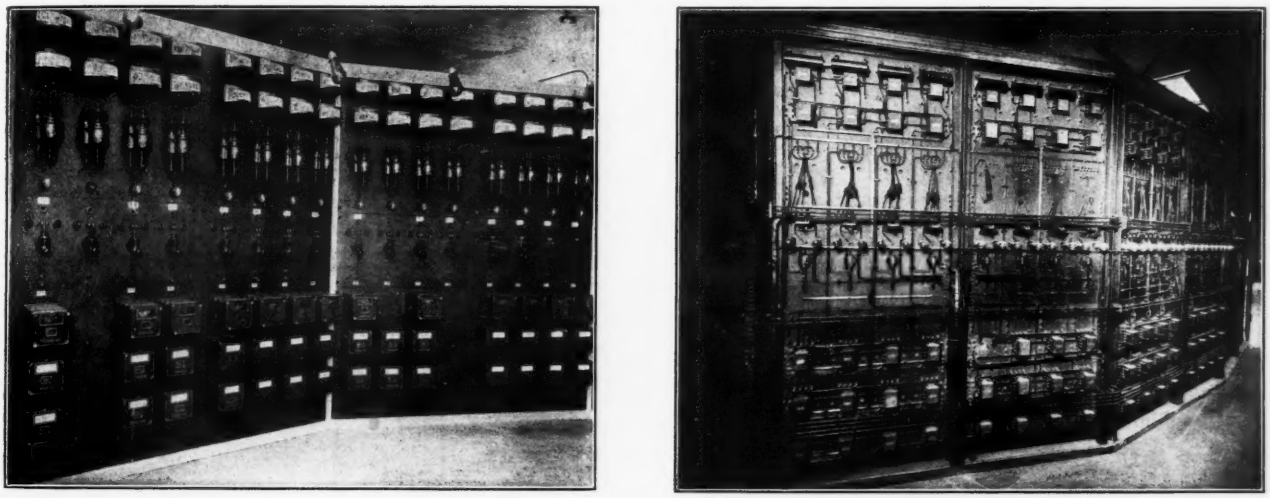
A conspicuous feature of each unit is the large ventilating duct bringing cool air from the basement up to the top of the generator, where the fan-like construction of the spider of the rotating field draws the air in and forces it through the field and armature laminations till it is finally discharged below the generator. This provision for cooling the generators has been found effective in keeping their temperatures well within safe limits even under steady full load.

The generator leads pass along the basement ceiling and run up to the oil switches on the second floor of the switch house. The busbars are arranged on the first floor on the vertical plan, *i. e.*, lying in separate compartments, one over the other. The arrangement of the oil switches on the second floor is such as to confine those on the side toward the turbine room for connecting the generators with the various sets of busbars. The oil switches in the south half of the room control the outgoing feeder lines. In the middle of the building the switch house is carried up to have a third story, the main feature of which is the operating room. This has its two switchboards arranged in an oval shape; the one toward the north, overlooking the turbine room, controls the generators and exciters on the bench-board plan. The switchboard toward the south is for the outgoing lines. A front and back view of the latter board are shown in views herewith. Special provision has been made for rapid testing of the switchboard instruments by means of test adapters. The oil switches have been provided also with special dis-connective devices to insure safety to any men making changes in the cables or switching arrangements. All the oil switches are remote controlled from the operating room as briefly described above. The outgoing lines pass from the southern row of oil switches into the cables leading to the underground system.

Besides the exciters in the turbine room, there is provided a storage battery in the basement for insuring a steady, uninterrupted exciting current. The substation in the southwest portion of the switch house contains a split-pole rotary converter of 500-kilowatt capacity and its auxiliary step-down transformers for supplying 115 and 230 volt current for motor and lighting service throughout the plant. There is now installed temporarily in the turbine room a 2,000-kilowatt vertical-shaft frequency-changer converting the 9,000-volt, twenty-five-cycle current generated in the main units to 4,000/2,200-volt, sixty-cycle current for a part of the alternating current distribution system.

Previous to its removal there will be installed in a room just east of the entrance hallway on the first floor of the switch house a vertical frequency-changer of 5,000-kilowatt capacity, which will comprise a 9,000-volt, twenty-five-cycle synchronous motor direct-connected through a vertical shaft to a 12,000-volt, sixty-cycle generator. This unit is the first one of this size as yet built. A large number of 2,000-kilowatt units of this type are in service throughout the system. The new unit will supply the new 12,000-volt, sixty-cycle cable system which is being installed for the more remote substations in the Edison Company's retail alternating-current distribution.

Some of the three additional generating units, which will complete the equipment of this station, will probably be 12,000-volt, sixty-cycle machines. In this case these, of course, will be operated in an entirely distinct system from the 9,000-volt, twenty-five-cycle units. It has been found that the alternating-current retail load has increased fast enough to warrant the generation of sixty-cycle cur-



FRONT AND BACK VIEWS OF SWITCHBOARD FOR OUTGOING LINES, QUARRY STREET STATION.

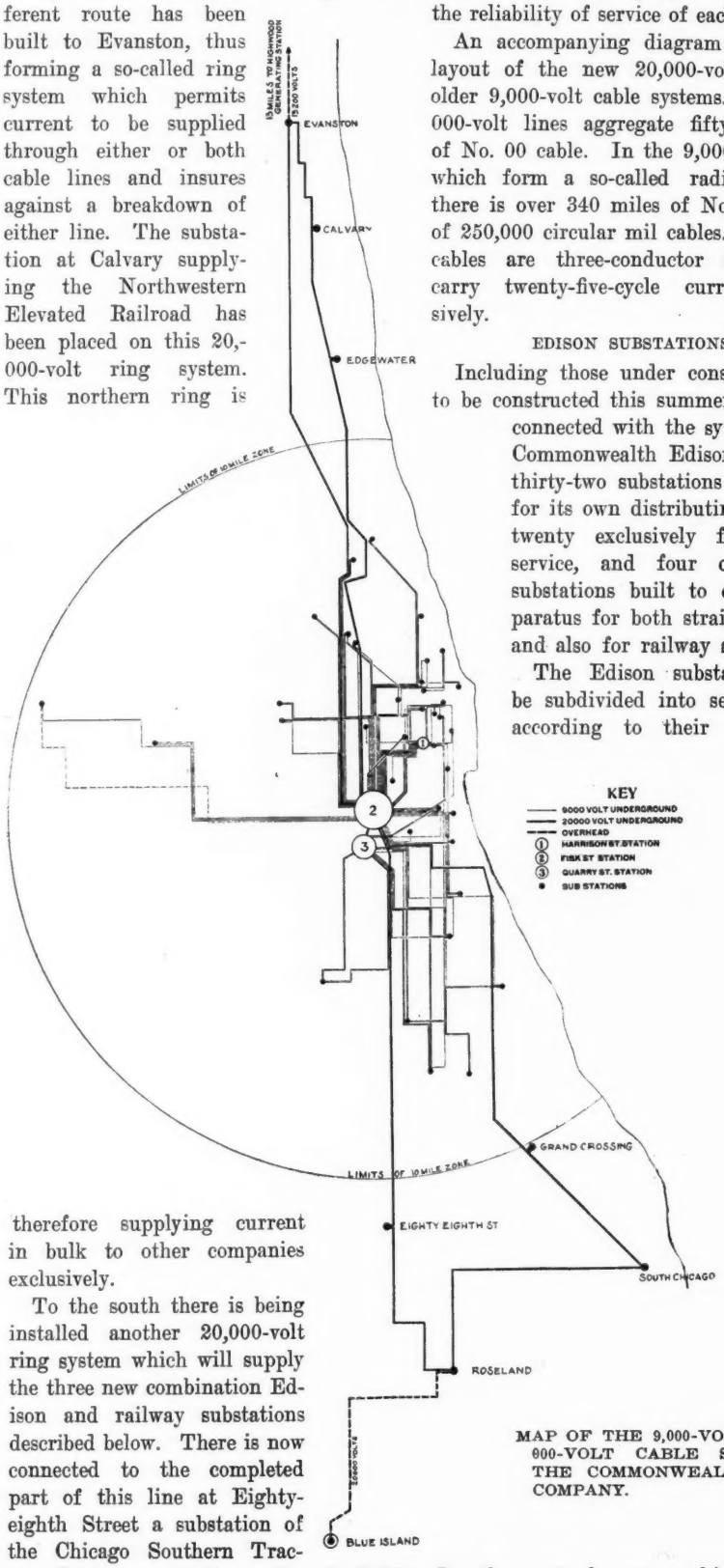
rent directly and at a voltage suitable for transmission through the cable system without the use of step-up transformers and motor-generator frequency-changers. The 5,000-kilowatt unit of the latter type, which was referred to in a preceding paragraph, will not only carry a portion of this sixty-cycle load during the construction of these additional generators, but after their installation will serve as a connecting link between the two systems, enabling the conversion of twenty-five to sixty-cycle current or the reverse, as conditions may demand.

Before closing reference to the Quarry Street station mention of the high economy attained therein is necessary. Although complete efficiency tests of the two units now running have not yet been made, the operating records indicate that they are probably even still more efficient than the later Fisk Street units. One contributing factor in this increased economy is the greater vacuum attainable in the condensers. During the winter months, when the river water used for condensing purposes is at quite a low temperature, a vacuum close to 29.4 inches has been attained. This is believed to be the highest vacuum as yet developed continuously in commercial operation. The attainment of such a high vacuum has a material effect in improving the performance of the steam turbine. Another contributing factor toward efficiency is the cooling arrangement of the generators alluded to above.

Both the Fisk and Quarry Street stations are operated together as a combined generating station, although sectionalizing is carried out to quite a degree. The entire operation is under the control of one staff of engineers and operatives, with Fisk Street as its headquarters. When these two stations are completed to their original plans of fourteen units in Station No. 2 and six units in No. 3 there will be concentrated in these two stations a maximum generating capacity of 252,000 kilowatts in twenty turbo-generating units.

TRANSMISSION SYSTEM.

The transmission system of the Commonwealth Edison Company is practically all in underground cables. Until two years ago 9,000 volts was the potential used throughout on this equipment. At that time it was decided to run a line to Evanston, connecting with the system of the North Shore Electric Company and the lines of the Chicago and Milwaukee Electric Railroad. This eleven-mile line proved quite satisfactory. It has been extended to the new transformers at the Fisk Street station referred to above, and another line following a different route has been built to Evanston, thus forming a so-called ring system which permits current to be supplied through either or both cable lines and insures against a breakdown of either line. The substation at Calvary supplying the Northwestern Elevated Railroad has been placed on this 20,000-volt ring system. This northern ring is therefore supplying current in bulk to other companies exclusively.



MAP OF THE 9,000-VOLT AND 20,000-VOLT CABLE SYSTEM OF THE COMMONWEALTH EDISON COMPANY.

To the south there is being installed another 20,000-volt ring system which will supply the three new combination Edison and railway substations described below. There is now connected to the completed part of this line at Eighty-eighth Street a substation of the Chicago Southern Traction Company. At the south end of this loop a connection will be made with the Blue Island station of the North Shore Electric Company. This will permit the interchange of current between the North Shore and Edison systems and increase the reliability of service of each.

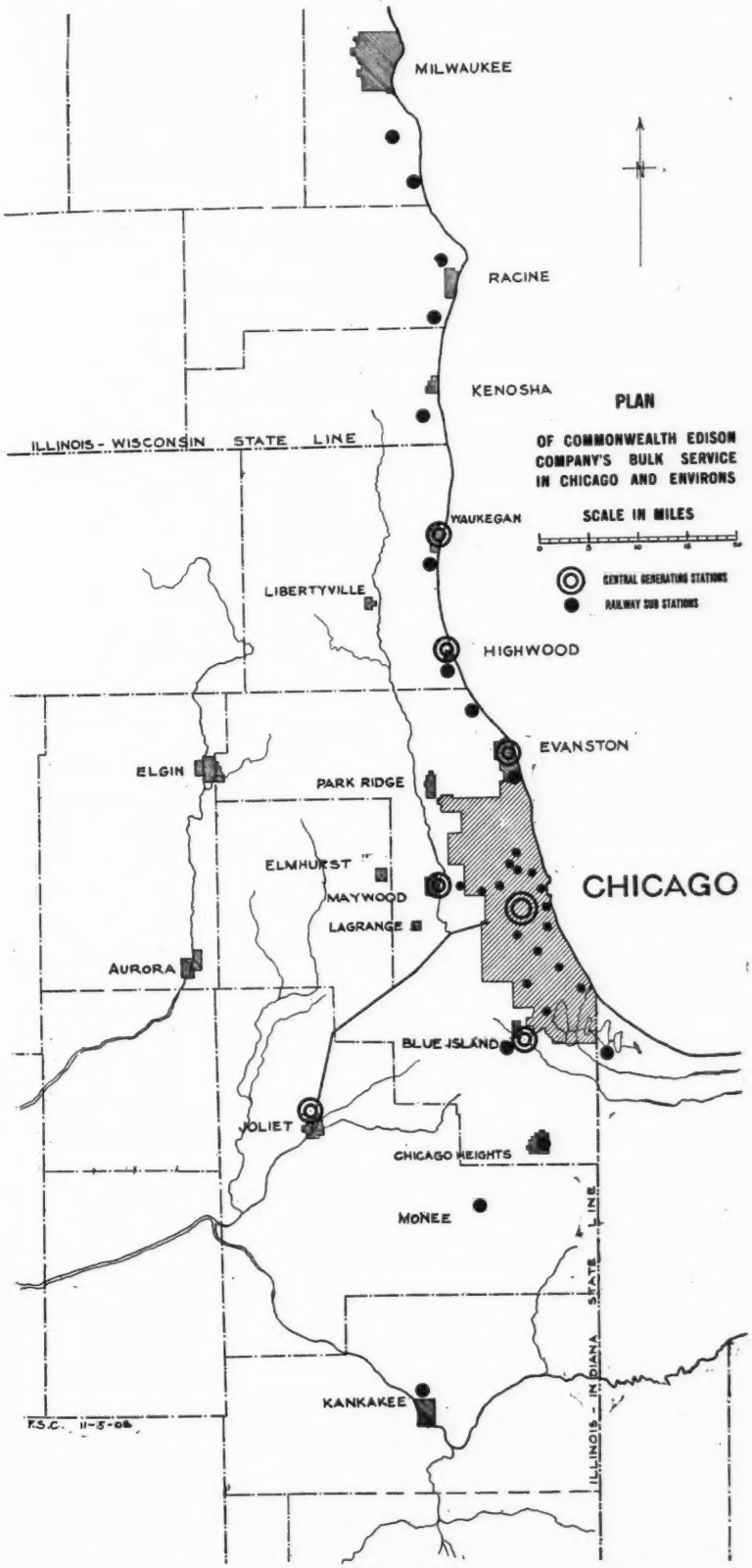
An accompanying diagram shows the layout of the new 20,000-volt and the older 9,000-volt cable systems. The 20,000-volt lines aggregate fifty-five miles of No. 00 cable. In the 9,000-volt lines, which form a so-called radial system, there is over 340 miles of No. 0000 and of 250,000 circular mil cables. All these cables are three-conductor cables and carry twenty-five-cycle current exclusively.

EDISON SUBSTATIONS.

Including those under construction or to be constructed this summer, there are connected with the system of the Commonwealth Edison Company thirty-two substations exclusively for its own distributing network, twenty exclusively for railway service, and four combination substations built to contain apparatus for both straight Edison and also for railway service.

The Edison substations may be subdivided into several types according to their equipment. In the central zone, which includes downtown Chicago and its adjacent manufacturing district where the load

is very dense, the distribution is entirely by direct current at 115 and 230 volts from rotary-converter and storage-battery substations, there being twenty-one that contain rotaries, and of these twelve are also equipped with batteries. There are three exclusively for storage batteries. The Plymouth Place substation also contains batteries and rotaries for railway service. On the border of this dense zone are two substations having both rotary converters and frequency-changers for direct-current distribution within the zone and for sixty-cycle alternating-current distribution in the outer zone. In this latter district there are four substations equipped so far with frequency-changers only. Beyond this zone there are being erected three combination substations receiving 20,000-volt, twenty-five-cycle current that will be described briefly below.



MAP OF THE RAILWAY AND OTHER WHOLESALE SERVICE OF THE COMMONWEALTH EDISON SYSTEM.

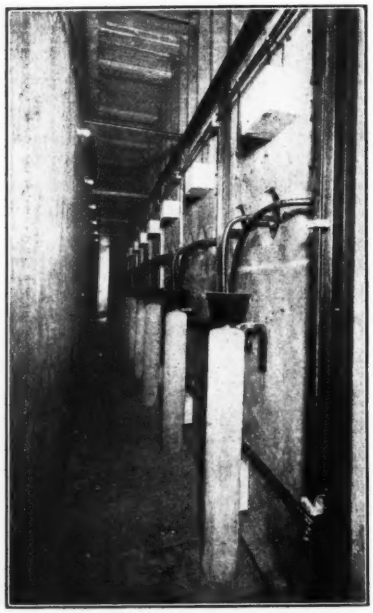
In these Edison substations there will be installed by this fall a total capacity of 52,300 kilowatts in seventy-eight rotary converters, 32,500 kilowatts in twenty-four frequency-changers, and twenty storage batteries, having a combined capacity of 18,000 kilowatts at the one-hour discharge rate.

Among some of the changes just carried out or contemplated in the older substations are: The installation of a 1,000-kilowatt split-pole rotary converter at West Division Street; the removal of the 2,000-kilowatt vertical frequency-changer from its temporary location at Quarry Street to th Fifty-sixth Street substation, which is the only one of the former generating stations where the generating equipment has been retained for emergency or winter peak-load service. At the Market Street substation all the old engines and generators have been disposed of, and a storage battery of the new Exide type built by the Electric Storage Battery Company especially for central-station work will be installed on the fourth floor; outside of New York this is the first battery of this type to be installed for central-station service. This battery will have a capacity for discharging 22,000 amperes in emergencies.

At Twenty-second and Troy streets there will be erected this summer a substation of a new type, which will include three-phase step-down transformers receiving 12,000-volt, sixty-cycle current and reducing its potential to 4,000/2,200 volts for the local distribution. This will be the first of the substations to receive the 12,000-volt, sixty-cycle current, which will be either generated or converted at the Quarry Street station as previously mentioned.

In the southern portion of the city three combination substations are being erected. Two of these, namely, at South Chicago and at Roseland, will take the place of former substations which were step-down transformer stations receiving

sixty-cycle current from the Hyde Park substation at 8,250 volts. The latter station was at Fernwood and when the Roseland station is finished this one will be dismantled. At Grand Crossing is being built the third of these new substations. At the present time it will include equipment for the railway service only. In each of these substations half of the building is reserved for the use of the Edison Company for its sixty-cycle distribution system. The equipment in this portion will include two 1,000-kilowatt frequency-changers at South Chicago and two 500-kilowatt machines of this type at Roseland. The equipment for the railway service is to be installed and operated by the Chicago City Railway Company, which has recently leased and is

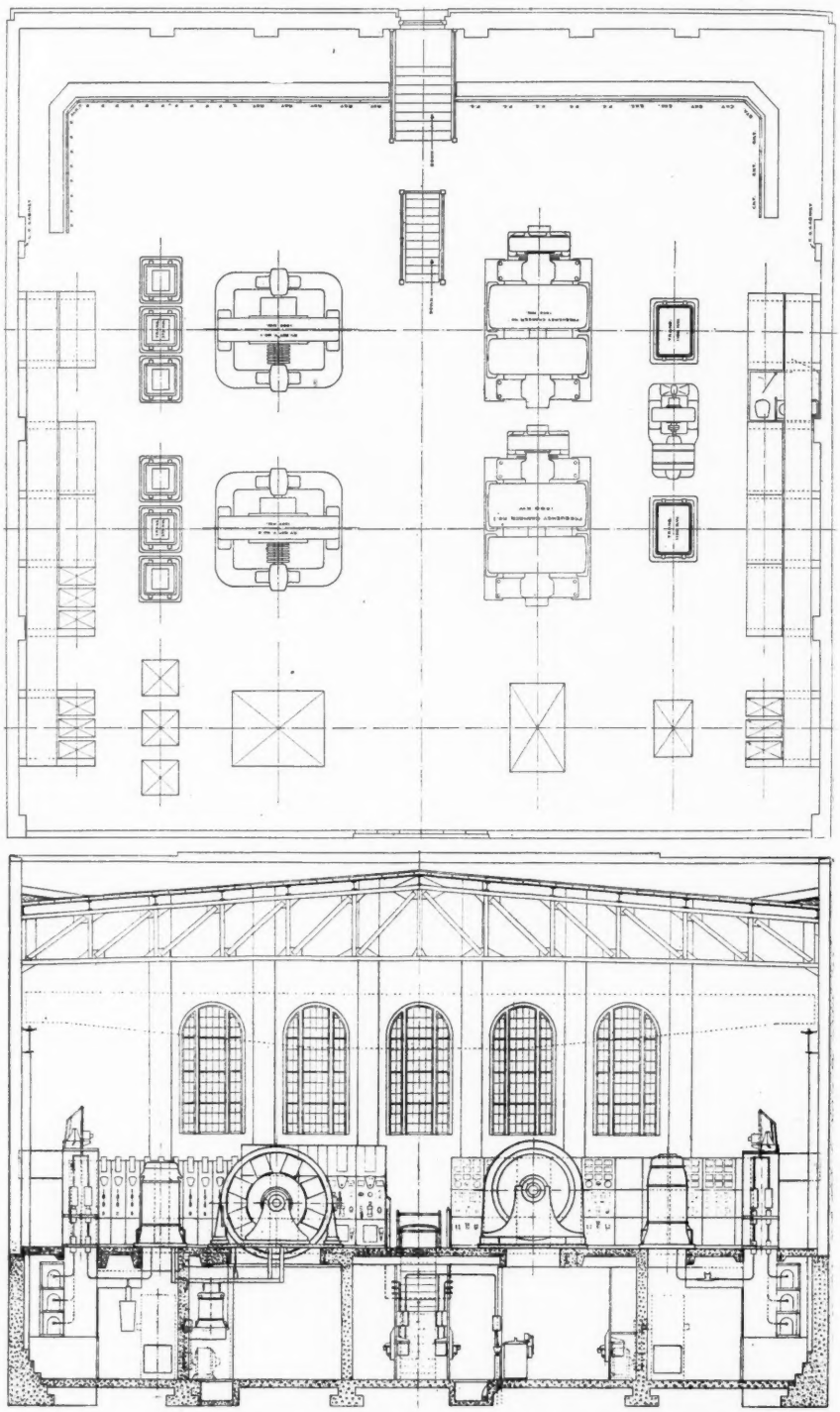


CABLE BELLS OF OUTGOING LINES, QUARRY STREET STATION.

operating the lines of the newly consolidated Calumet & South Chicago Railway Company. For this railway service there will be installed two 1,000-kilowatt rotary converters in each of the stations. The general arrangement of these substations is shown quite clearly by the accompanying general plan and cross-sectional elevation of the substation at South Chicago, which is typical of all of them.

RAILWAY LOAD.

One of the most successful features of the Commonwealth Edison Company's business has been the rapid growth of its wholesale supply to the electric traction and elevated railway companies of Chicago. This development began in 1902, when the Chicago & Oak Park Elevated Railroad, which had never owned a power house of its own, found that the surface traction company from which it bought its power could no longer supply it. A substation at Lake and Rockwell streets was therefore established and supplied with twenty-five-cycle current at 9,000 volts.



PLAN AND CROSS-SECTIONAL ELEVATION OF SOUTH CHICAGO COMBINATION SUBSTATION.

The steady increase of traffic of the street-railway companies at a time when their money-raising power was poor, due to the uncertainty of franchise renewal, suggested an offer from the central-station company to provide the additional required energy from its system at a very low rate and at a comparatively small capital outlay on the part of the traction companies for substation equipment. This proposal brought welcome relief from a gloomy situation, since the traction power houses of one company at

least were getting antiquated and inefficient and there was urgent need of transforming the unsatisfactory cable lines to electric service.

The success from all points of view of the substation service thus established led to its rapid extension, till at the present time the South Side Elevated Railroad is the only Chicago traction company which has not availed itself of Edison service. The Chicago & Oak Park Elevated Railroad buys all its power from the Edison Company. After June 1 the Chicago City Railway Company will likewise take all its power from the central station. Including the substations now under construction there are at the present time connected with the system of the Commonwealth Edison Company the following numbers of railway substations and rotary-converter equipments:

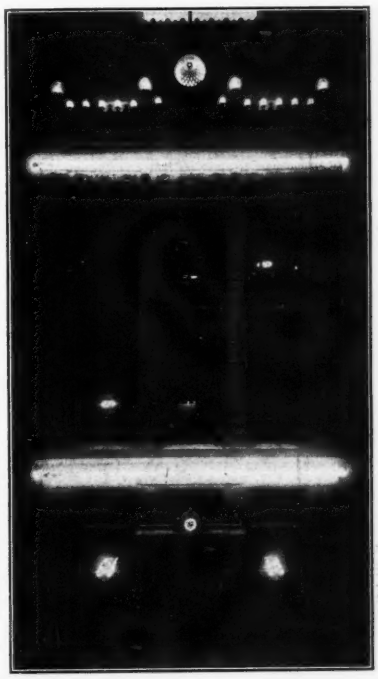
Railway Companies.	No. of Substations.	No. of Rot. Conv.	K. W. Capacity Rotaries.
Chicago City Railway	8	30	46,400
Chicago Railways	5	15	30,000
Northwestern Elevated	3	5	10,000
Chicago & Oak Park Elevated	2	6	6,000
Metropolitan Elevated	2	4	6,000
Total	20	60	98,400

As indicated by these figures the railway service of the company constitutes something over sixty per cent. of its total load.

There should be added to the figures above the current supplied to the Illinois Tunnel Company for operation of its freight tunnels in the downtown district. This is supplied from five rotary-converter equipments installed at the Harrison Street, Jackson Boulevard and Randolph Street substations, aggregating 2,600 kilowatts. This service is supplied at 250 volts.

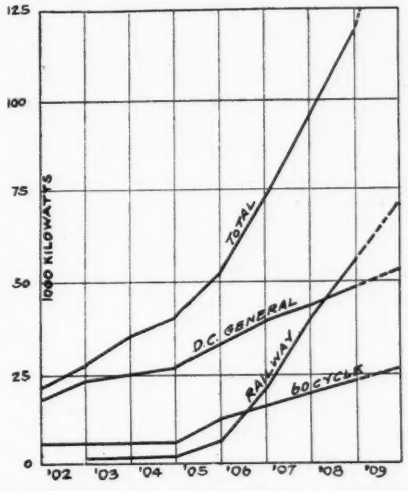
There should also be included in the wholesale load of the company that which it furnishes to the North Shore Electric Company at Evanston, and about half of which is used for the supply of the Chicago and Milwaukee Electric Railroad. This latter company receives about 1,500 kilowatts of energy at the Evanston end of its line, and about 1,000 kilowatts from the Waukegan station of the North Shore Electric Company. There are on this system a total of ten substations working partly in parallel with its own generating station at Highwood, Ill. At night, however, this latter station is shut down and then the current of the Commonwealth Edison and North Shore systems operates the entire line from Evanston to Milwaukee, except that at times current is also furnished to the north end of the line by the Milwaukee Electric Railway and Light Company.

The North Shore Electric Company supplies from its Blue Island station about 2,000 kilowatts for the use of the Chicago Southern Traction Company, which has shut down its generating plant



NIGHT VIEW OF THE MAIN OFFICE OF THE COMMONWEALTH EDISON COMPANY.

at Eighty-eighth Street. This current is supplied at 9,000 volts north of Blue Island and at 33,000 volts south of Blue Island. There are five substations on this traction system, which extends from



GROWTH OF THE AVERAGE ANNUAL LOAD IN DIFFERENT CLASSES OF SERVICE.

Sixty-third Street in Chicago to Kankakee, Ill. As briefly mentioned in a preceding paragraph, the Economy Light and Power Company supplies current to four traction systems. The great extent and the importance of the entire railway load is made evident from the accompanying map, which shows the location of most of the railway substations connected to the combined Edison systems from Milwaukee to Kankakee. The rapid growth of the railway load and its relation to the total load is indicated in the accompanying diagram, which also shows the growth and relation of the sixty-cycle and direct-current loads.

The current supplied from the Commonwealth Edison Company to these various railway companies is converted by the latter into direct current at from 500 to 600 volts by means of substation equipments owned and operated by the traction companies. The current is sold in bulk and is measured at the generating power house switchboard. The cable lines are owned by the Edison Company. The rates charged for this energy are extremely low. In the largest contract covering this class of service they comprise a primary charge of $15 per annum per kilowatt of maximum demand; this corresponds to the fixed charges on the generating and transmission equipment. Secondly, there is a charge which is as low as $.00415 per kilowatt-hour and which corresponds to the operating costs for supplying the energy.

CONCLUSION.

Although the railway load has increased by leaps and bounds within the last two years, there has been a steady increase in the retail motor and lighting load. This retail load includes all that supplied as direct current or sixty-cycle alternating current from the central station company's own distributing system. Among these so-called retail customers are the Cook County and Federal public buildings, many of the large office buildings, practically all of Chicago's department stores, and a large number of great manufacturing and industrial plants. There are also connected with the system a rapidly increasing number of smaller factories and shops of all kinds, stores, schools, churches, hotels, apartment buildings, etc. There has been a wonderful increase in the distinctively residence service, not merely for lighting, but likewise for miscellaneous domestic purposes that have become so popular of late. The total connected load of the system, exclusive of the railway load, is equivalent to 4,571,000 sixteen-candlepower lamps, *i. e.*, about 228,550 kilowatts.

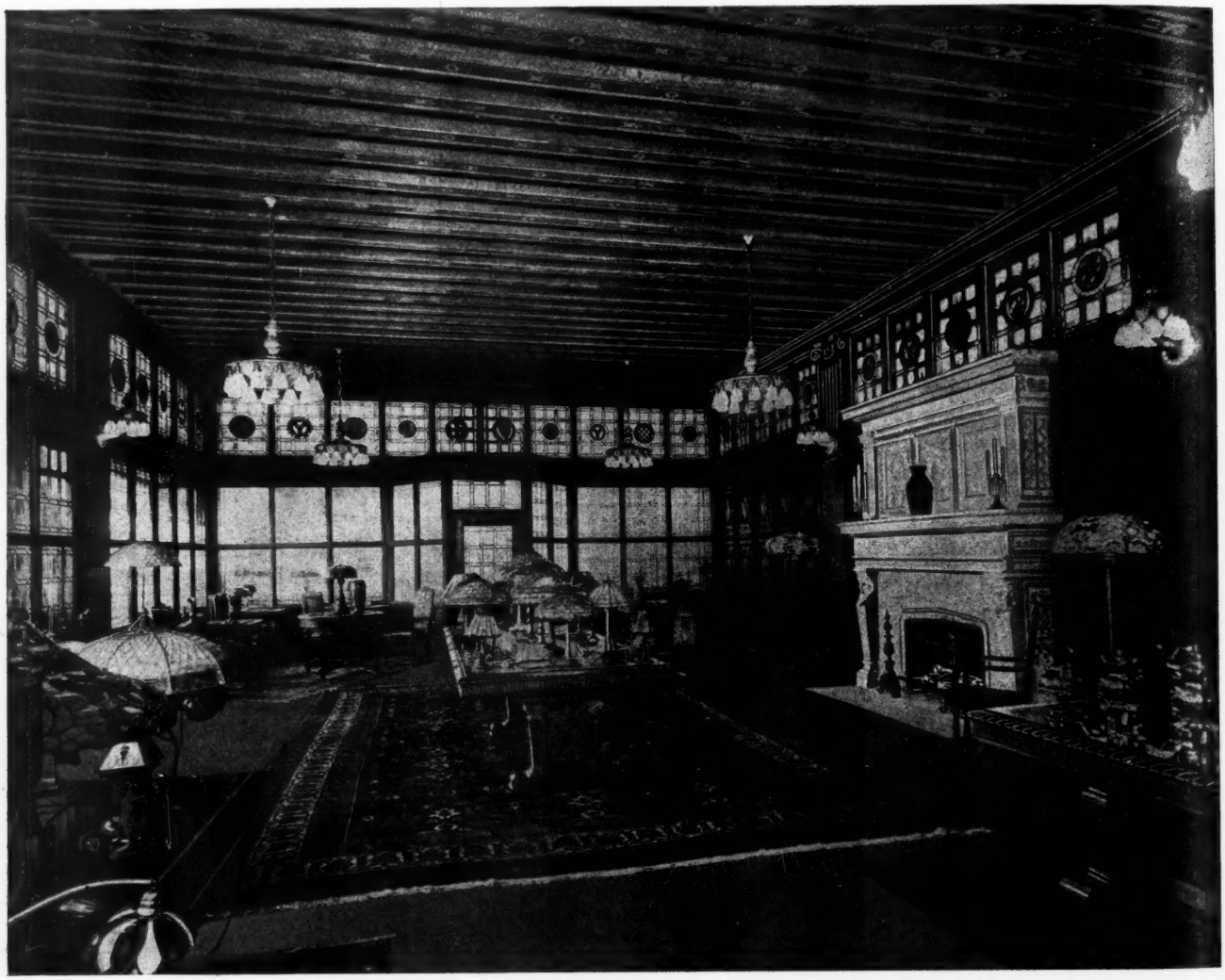
The growth of the retail business has been brought about by an aggressive campaign of popularizing electricity and electrical appliances for power, lighting,

heating, and miscellaneous purposes. By means of extensive advertising, by its support of the now well-known monthly magazine *The Electric City,* and by various methods with which the public is now quite familiar, the company has carried on a very successful publicity campaign. Among the recent special features to be noticed in this connection is the plan of loaning 10,000 electric flatirons for a six-months' trial, which has been partly concluded with exceptionally good results.

At the close of January last there was opened in the Railway Exchange Building, at the corner of Jackson and Michigan boulevards, the company's new "Electric Shop," which has attracted wide attention, not only among the citizens of Chicago, but among its constantly large number of visitors. The primary purpose of establishing this shop was to sell all kinds of electrical appliances suitable particularly for domestic and small power users. The artistic manner in which this shop has been equipped is shown excellently by the large accompanying illustration of a general interior view. In the basement below the shop proper are exhibited a large number of motors suitable for domestic and various small power purposes. In a portion of this basement is located the Jackson Boulevard substation of the company.

No article dealing with the system of the Commonwealth Edison Company and its methods is complete without an allusion to the personnel which is instrumental in keeping it to its high state of efficiency and progress. One of the most important factors in the success of the company is the hearty co-operation between its executive officers and its large numbers of employes. During the past year there has been organized among the company men a branch of the National Electric Light Association. This was one of the first of these company organizations to be started. It now has a membership of 479.

The headquarters from which the company affairs are directed are still located at 139 Adams Street, Chicago. A night view of this well-known building, as recently illuminated by a system of outline lighting including 192 twenty-five-watt tungsten lamps, is shown herewith. This building has become entirely inadequate to the expanding needs of the company, and an eight-story building, part of which houses the Market Street substation, has been taken possession of to give more adequate room for the office forces. Adjacent to this building are other structures belonging to the company, which in the near future will very likely be rebuilt to accommodate its various departments. All these changes are but symbolic of the enormous business being conducted by this probably the most progressive and enterprising central-station company in America.



GENERAL VIEW IN THE NEW "ELECTRIC SHOP" OF THE COMMONWEALTH EDISON COMPANY.

SOME PHYSICAL PROPERTIES OF CRYSTALLINE SILICON.[1]

BY CLARENCE IRVING ZIMMERMAN.

It has been estimated by Clarke[2] that the element silicon constitutes twenty-eight per cent of the earth's crust. It exists in the form of its oxide SiO_2, and this oxide constitutes sixty per cent of the earth's crust. Next to oxygen it is the most abundant element. The importance of knowing the various properties of silicon which can now be obtained in a relatively pure state in any quantity desired cannot be underestimated. We know a great deal about the properties of such metals as aluminum, iron, copper, zinc, tin, etc., and about such elements as sulphur, carbon, hydrogen, chlorine, etc., but about the element that is more abundant than all, with the exception of oxygen, we know very little.

Below is given a brief summary of some of the physical properties of silicon:

1. *Atomic weight*—28.4.

2. *Specific gravity*—2.35. Silicon is lighter than aluminum, the latter being 2.56 to 2.68.

3. *Molecular state of aggregation.*—Silicon is definitely known to exist in but two well-defined states, (1) the finely divided amorphous or non-crystalline state and (2) the isometric crystalline state. According to its method of preparation and according to the rate at which it passes through the change of state from liquid to solid the crystal habit and the sizes of the crystals themselves will vary, but the crystalline system remains isometric. The element crystallizes in needle-shaped forms, in flat plates and in skeletal crystals, all of which may present the appearance of rhombohedral and hexagonal forms.

A considerable quantity of gas is frequently found between the crystals or in pockets like blowholes. If the solidification takes place very slowly a very homogeneous but coarsely crystalline material may be obtained which contains no cracks or blowholes. Under some conditions of very slow cooling the degree of crystallization is so extreme that the material can be picked to pieces with the fingers, the separations taking place along cleavage planes. When solidifying silicon appears to expand. This may be partly, but not entirely, due to the giving off of gases. Some masses appear to be under a severe molecular strain. Conchoidal fractures are readily obtained, but when the crystals are small the fracture in cast silicon usually occurs along crystal faces or less readily on cleavage planes. Cleavage in massive specimens becomes evident when a plane surface is ground by means of an abrasive. The various crystals in the mass show their different orientation by the reflecting surfaces from the cleavage planes.

4. *Tenacity.*—Silicon is very brittle and is especially so in the cast form. The rate of cooling through the solidifying point, and probably the rate of cooling below the point of solidification affects the brittleness to a very marked extent. Cast silicon often, if not always, becomes more brittle by repeatedly heating it to a red heat and quickly cooling it in water. Aluminum, iron, manganese, and probably many other metals will bind the crystals in cast silicon together and toughen the mass somewhat, but for many purposes the presence of foreign elements or alloys is undesirable. The silicon itself is extremely resistant chemically, and so its properties will necessarily be somewhat different when any foreign material is introduced which is less resistant than silicon. No results on the proper rate of cooling silicon castings in order to give the strongest and toughest castings have been published.

5. *Expansion with temperature.*—No recent data on pure silicon are at present available. In 1864 Fizeau made some measurements upon crystalline silicon and found that the average coefficient of expansion from 0 to 100 degrees centigrade was .0000078. This would make it appear to be less than glass or platinum. The expansion coefficient varies with the temperature. It should be correlated with the electrical resistance curves shown in a later part of this article.

6. *Tensile strength.*—The highly crystalline state and the brittleness frequently prevent its use where small and delicate plates or rods are required, but in larger masses these objections partly disappear. No figures on the tensile strength of large masses are available. When rods are cut from blocks of homogeneous silicon the strength is apparently much greater than the strength of cast specimens. Rods cut from these homogeneous specimens might therefore be applicable where cast rods are not suitable.

7. *Hardness.*—On the scale of hardness used in determining the hardness of minerals silicon would be about six. It is like steel in hardness.

8. *Porosity.*—As was stated above, silicon is frequently porous, due to the gases which were liberated from the liquid mass when it changed its state. The openings sometimes do not appear to be present when they are really there. The openings may be between crystal faces. It is not impossible, however, to make solid castings or blocks.

9. *Melting point.*—Mendenhall and Ingersoll found the melting point to be 1,434 degrees centigrade, based upon the assumption that platinum has a melting point of 1,745 degrees. With an assumed value of 1,789 degrees for platinum they have given the figure of 1,452 degrees centigrade for silicon. I have obtained a melting point of 1,430 degrees in an electric furnace, the measurement having been made by a platinum-rhodium thermocouple. F. J. Tone has given a melting point of 1,430 degrees for silicon.

10. *Vapor tension.*—The vapor tension of silicon is practically zero up to the temperature of its melting point. In the vacuum furnace silicon is readily volatilized. It seems to me quite probable that above 1,800 degrees centigrade the vapor tension from the surface of liquid silicon is considerable, or many of the reactions known to occur in the silicon and carborundum furnaces could not be explained. Dr. H. N. Potter[1] has made a contrary statement regarding the volatility of silicon. Silicon carbide has a very much lower silicon vapor tension than the element itself. At the temperature of decomposition of silicon carbide, silicon vaporizes very readily; this point will vary with the amount of silicon dioxide vapor present. When the quantity of this vapor present is large, the temperature of the decomposition of the carbide is lowered. The boiling point, or the temperature above which the liquid does not exist, has not been determined. It is probably over 2,000 degrees, and may even be higher than 2,500 degrees centigrade.

11. *Specific heat.*—I am not aware of any recent determinations on the specific heat of silicon over a wide range of temperatures. Silicon, like carbon, changes its specific heat widely. Above 200 degrees it is supposed to be constant. Weber made some measurements a long time ago with these results:

Temperatures.	Specific Heat.
—40	.136
—57	.1833
128	.196
184	.201
232	.203

12. *Latent heat of fusion.*—No data are available. When making castings of

[1] Abstract of a paper read (May 8, last) by the late Prof. C. I. Zimmerman at the fifteenth general meeting of the American Electrochemical Society, at Niagara Falls, Canada.

[2] F. W. Clarke, "The Data of Geochemistry," United States Geological Survey Bulletin 330, p. 31, 1908.

[1] Dr. H. N. Potter, Transactions American Electrochemical Society, Vol. XII, p. 194.

silicon the material passes very quickly through the change from the liquid to the solid state. The latent heat of fusion seems to be quite low or else silicon is an excellent conductor of heat at its melting point.

13. *Heat of combustion.*—Considerable work has been done recently upon the heat liberated when the element oxidizes. W. G. Mixter obtained a figure of 191,000 calories per 28.4 grammes of silicon burned to silicon dioxide. Dr. H. N. Potter obtained a figure of 215,000 calories for the same amount. Without further confirmations I think it would be well to consider this point unsettled. Personally, I consider the lower figure to be the more conservative one. The rate of energy liberation when silicon combines with the oxygen of various metallic oxides in silico-thermic reactions seems to indicate that the higher figure may be doubtful.

14. *Thermal conductivity.*—The thermal conductivity seems to be quite high. This element has a low electrical conductivity and a high thermal conductivity. It does not seem to be the same as ordinary metals in this respect, but it is not the only exception in this apparent anomaly.

15. *Optical properties.*—Silicon has a dark silvery metallic luster, having a bluish tint something like that of a freshly-cut lead surface. The surface does not tarnish or corrode. A polished surface will thus remain polished almost indefinitely without losing its luster. The reflection of light from a polished surface is not nearly so perfect as from a silver surface, but for some optical and for ornamental purposes it might be valuable. Silicon has a high refractive index. In this respect it is similar to its carbide. Very finely powdered silicon is brown in color, resembling the amorphous variety in this respect. Its optical properties are being investigated at present.[1]

16. *Spectrum.*—The flames which come from a silicon or a carborundum furnace are of a greenish-yellow color. The silicon flame color is usually masked by the ever-present sodium spectrum. With a small pocket spectroscope there are thirteen prominent lines observed and many faint ones. The silicon furnace flame colors are:

	Lines.
Red	2
Orange	1
Yellow (Na)	1
Green	2
Blue and violet	7

17. *Magnetic properties.* — St. Meyer published some data on the magnetic behavior of silicon. For all practical purposes it is non-magnetic. Silicon-iron alloys will decrease in magnetic susceptibility until the silicon content increases to thirty per cent. Above this these alloys are practically non-magnetic.

18. *Electrical properties.*—The electrical properties and constants of silicon are exceptionally interesting because they are quite different from metallic conductors. Some of these will be discussed below.

A. *Thermo-electric properties.*—Heath[1] found that the junction of silicon and metal exhibits high thermo-electromotive-forces when heated. The magnitude and the direction of the electromotive-force generated will vary greatly in different specimens. Sometimes the current will flow in one direction across the hot junction and sometimes in the opposite direction. A single specimen may have positive and negative spots. This peculiar ability for a given substance to exhibit high thermo-electric forces in different directions at the contact with a metal or other conductor is not new, nor is it characteristic of silicon alone. It is quite a common phenomenon among mineral substances and was investigated to some extent twenty-five years ago. Miss Frances G. Wick[2] and Dr. L. W. Austin[3] have published some results on the thermo-electromotive-forces of silicon-metal contacts. They have stated that the usual direction of current flow is from silicon to copper through the hot junction. My own observations are just the reverse. The usual direction is from the copper to the silicon across the hot junction in a copper-silicon couple. I have tested this out on forty or fifty different specimens of silicon which covered a wide range of physically and chemically different samples. I have also tried a number of alloys of silicon against a metal and have found that in nearly all of the cases the silicon was the positive side of the hot junction, as is shown in Fig. 1. A few of the specimens which did not follow my above-described usual thermo-electric direction at ordinary temperatures reversed their effects when the temperature of the silicon itself was raised considerably above the temperature at which the first observation was made. There was no reversal of direction in what I have called my normal specimens, even when they were raised to a very much higher temperature than that which reversed the abnormal specimens. Further work on this line is in progress.

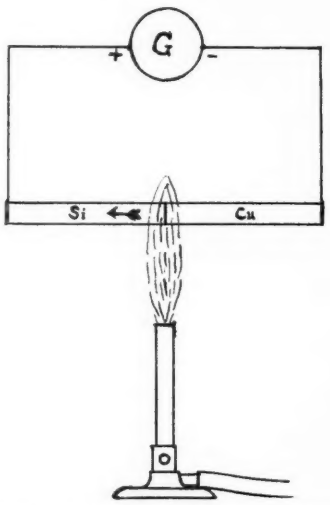


FIG. 1.—DIAGRAM SHOWING THERMO-ELECTRIC PROPERTIES OF SILICON.

B. *Rectifying properties.* — The characteristic unilateral or asymmetric conductivity which is observed at the contact surface between almost any two heterogeneous conductors is quite marked at the contact surfaces between silicon and metals. The current will pass across a silicon-metal junction much more readily in one direction than in the other. If the area of contact between silicon and a metal be varied the degree of unilateral conductivity for a given current flow will also vary. Hence, if an electric circuit contains a piece of silicon held between two metal contact pieces and if the areas of contact on the two sides of the silicon are different, that circuit will be a unilateral conductor. If an alternating current be then passed through this circuit which possesses asymmetric or unilateral conductivity there will be a tendency to stop one half-wave and to pass the other half-wave. G. W. Pickard[1] was probably the first person to note that this effect could be utilized for wireless-telegraph waves when silicon was one of the rectifying elements.

Extensive use of the silicon rectifier has been made in wireless telegraphy.[2] By a proper disposition of silicon rectifiers and of electrical condensers the energy of the short oscillatory trains of waves caught by an aerial can be stored in the condensers and subsequently discharged through a telephone receiver or through a galvanometer. Without rectification and without any means for stor-

[1] Mr. Littleton and others. Physics Laboratories, University of Wisconsin.

[1] Heath, United States Patent No. 824,015, June 19, 1906.

[2] F. G. Wick, Physical Review, Vol. XXV, No. 5, p. 382.

[3] Austin, Bulletin of the National Bureau of Standards, August, 1908.

[1] G. W. Pickard, United States patents 836,531, 877,451 and 888,191.

[2] G. W. Pickard, ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, February 20, 1909.

ing the energy caught by the aerial the telephone receiver will not detect the waves. The condenser may be the aerial itself, or the telephone receiver. I have constructed some exceedingly sensitive wireless receiving circuits based upon the use of one or more of such crystal rectifiers with electrical condensers and galvanometers. Ordinarily only one such rectifier is used in commercial receiving circuits, and in such cases only a part of the energy of the oscillatory waves can be detected. The direction of the first half-wave of a strongly damped oscillatory train makes a great difference in the sensitiveness of a receiver containing only one silicon detector or rectifier. In this case much of the energy and also the highest electromotive-force of the damped waves come in the first pulse.

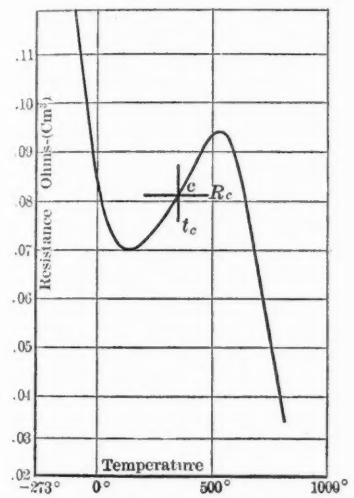


FIG. 2.—RESISTANCE-TEMPERATURE CURVE. SILICON ROD NO. 1.

There is no thermo-electric action in the silicon detector. It is an interesting phenomenon, still to be explained, that the thermo-electric and rectifying actions of silicon-metal contacts and other similar crystal rectifiers are usually such that the current flows through the rectifying contact in opposite directions in the two different cases. No doubt there is a simple explanation for this relation. Just as there are numerous substances which, when placed in contact, will produce high thermo-electric forces when the junction between two of them is heated, so there is a long list of substances which show a marked rectifying action like that which silicon exhibits. Carbon and tellurium show these thermo-electric and rectifying effects to a marked degree when in contact with other conducting substances. The list of conducting mineral substances which show this same effect is too long to be given here. Almost all of them show this to a more or less marked extent.[1]

C. *Hall effect.*—When a current of electricity flows across a conducting silicon plate which lies perpendicular to the direction of a strong magnetic field the current in the plate will take a different course than when the strong magnetic field is not present. The path of the current tends to be rotated more and more as the magnetic field increases. In silicon this effect is quite marked. It varies greatly with different samples of silicon and is roughly related in magnitude to the thermo-electric forces. Dr. Smith has investigated the Hall effect quite extensively in silicon and other substances. In silicon he finds the Hall effect reversible like the thermo-electric and rectifying properties.

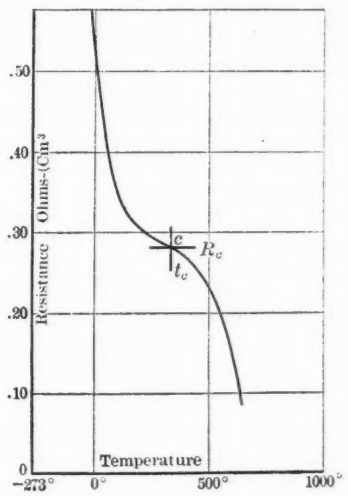


FIG. 3.—RESISTANCE-TEMPERATURE CURVE. SILICON ROD NO. 2.

D. *Electrical resistance.* — The electrical resistance of silicon also shows some exceptionally varied and interesting results. Two years ago Dr. C. P. Steinmetz presented before this society in a lecture on "Conduction" some results on the relations between temperature and electrical resistance. He classified electrical conductors in a general way and stated that the resistance of certain specimens of cast silicon seemed to give an intermediate link between pyro-electrolytic and metallic conduction. Miss F. G. Wick investigated the electrical resistance of some rods of silicon similar to those which Dr. Steinmetz discussed. Their results showed that cast silicon varied widely in its resistance characteristics in different specimens. Some specimens showed a negative temperature coefficient throughout the range of temperatures which they studied, whereas other specimens showed a temperature coefficient which was at first positive and afterward negative, and still others showed a change from negative to positive and then back to negative characteristics. Cast silicon rods were used in their measurements.

In Figs. 2 and 3 are shown curves plotted from experimental data which I

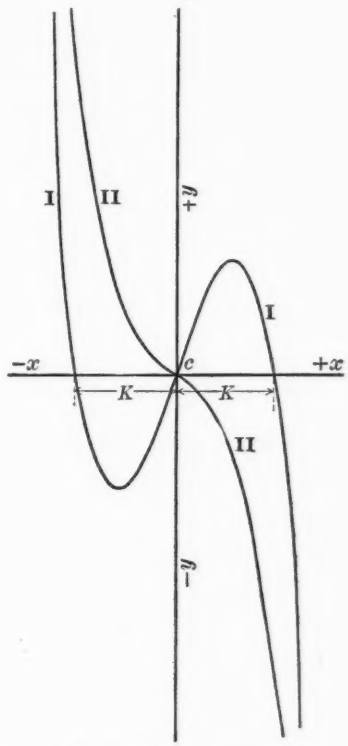


FIG. 4.—CUBIC CURVES PLOTTED FROM MATHEMATICAL EQUATIONS.

have obtained from two specimens of silicon rods which were cut from homogeneous masses of slowly cooled, relatively pure and coarsely crystallized material. The temperature range covered was from 190 degrees to nearly 800 degrees centigrade. The impurities in these rods are given below:

	Rod No. 1.	Rod No. 2.
Fe	0.32%	0.29%
Al	0.14%	0.17%
C	Trace	Trace
CA, Mg, Mn	Trace	Trace

In these two diagrams there exists a cubic relation between the co-ordinates of the curves. In order to show this cubic relation more plainly I have drawn two curves in Fig. 4 from the equation of a cubic curve having the formula

$$y = m(K^2 x - x^3).$$

In curve 1, $m = 0.05$ and $K^2 = +60$.

In curve 2, $m = 0.02$ and $K^2 = -30$.

In curve 1 of Fig. 4, the factor K is equal to the horizontal distance between

[1] For interesting and valuable data see Pierce, Physical Review, March, 1909. Also Pickard's article in these columns, referred to above.

the center of the cubic curve and the points at which the curve cuts the axis.

In curve 2 of Fig. 4, K is an imaginary quantity, as it is the square root of the negative quantity — 30.

The close resemblance between the experimentally determined curves shown in Figs. 2 and 3 and those drawn from the formula $y = m(K^2 x - x^3)$ and shown in Fig. 4 is striking. Were this relation exact the general formula for the resistance of silicon rod No. 1 would be exactly the same as the formula for the resistance of silicon rod No. 2. For rod No. 1 the factor K^2 is a positive quantity and for rod No. 2 the factor K^2 is a negative quantity. The factor m would be the same for both rods if the scales for the co-ordinates of temperatures and resistances were the same.

Since the origin of the co-ordinates in the curves shown in Figs. 2 and 3 is not at the center of either of the curves, the formula for the resistance-temperature relations of the silicon rods is not quite so simple as the formula for the curves shown in Fig. 4. The constants which must be applied to the theoretical formula in order to make it apply to the experimentally determined curves have very interesting physical significances. At present I do not wish to draw any general conclusions, as I wish to continue these investigations with different silicon rods.

As a theoretical formula for the resistance of the silicon rods, assuming the curves to be true cubic curves, and referring the curve to the co-ordinates used for plotting the curve we get:

Resistance $= m(K^2 t - t^3)$ referred to the centers of curves.

Resistance $= R_c + m[K^2(t - t_c -)(t - t_c)^3]$ referred to the co-ordinates as plotted.

This may be written:

Resistance $= a + bt + ct^2 + dt^3$.

The cause of the marked differences in the specific resistance of the two rods is not yet definitely known. It may be due to the difference in the chemical composition alone, but it is probably due largely to a difference in the physical condition of the molecular aggregates in the two samples.

Electrical Supplies for the United States Navy Department.

The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on June 1 for 5,000 feet of electric-light wire (Schedule 1271), for delivery at the Brooklyn (N. Y.) Navy Yard.

Reduces Rent of Lighting Fixtures.

The Commonwealth Edison Company of Chicago has twice reduced the rental charge for tungsten clusters; first, from $1.50 a month to $1.25, and now to $1 a month. This charge includes wiring, fixtures, lamp renewals and care.

The charge now made is for three hours' use of the lamps each day—exclusive of light, which is furnished on the regular meter basis. There is a slight increase in the cost of the rental when the lamps are used over three hours a day.

Western Electric Reports Big Increase Over 1908.

In common with other industrial organizations which have reported substantial gains in business during the last two months, the Western Electric Company's April returns make a slightly better showing than March, which was considerably the best month in the fiscal year to that time, and April, 1909, is nearly fifty per cent ahead of the returns for April, 1908. In view of the company's steady expansion during the last ten years and the high record for the "peak" year of 1906, when sales ran up to $69,245,331, an increase of more than $25,000,000 over the preceding year, it is difficult to determine, in making comparisons, what shall be taken as the "normal" year, but at the present time the Western Electric is operating at the annual rate of sixty-five per cent of the record of 1906 and about eighty-five per cent of the record of 1907, which was the second best year in the company's history.

From the above percentages and with the business of the Western Electric running at the rate of $45,000,000 during the part of the current fiscal year which has elapsed, it would be conservative to say that at the present time the company is operating at about seventy-five per cent of what might be called a normal year. On the basis of April, the sales are running at the rate of about $48,000,000 per annum, which would bring April's business close to $4,000,000. The first five months showed a rate of about $45,000,000 a year, but the company will undoubtedly make a better showing than this, since the improvement to date is undoubtedly of a permanent nature.

Electrical Exports for March.

The total electrical exports from the United States for the month of March showed a good improvement, since the slight decrease in electrical machinery from the preceding month was more than made up by a marked increase in electrical appliances. Compared with a year ago there was a substantial increase.

The official statistics prepared by the United States Department of Commerce and Labor are as follows:

	March, 1909.	February, 1909.	March, 1908.
Appliances	$ 681,083	$ 462,856	$ 444,542
Machinery	579,499	598,736	690,636
Total	$1,260,582	$1,061,592	$1,135,178

Below is given a list of the principal countries to which electrical products were exported in March, 1909, and also the value of these exports:

Exported to—	—Electrical— Appliances.	Machinery.
United Kingdom	$ 63,327	$ 60,030
Belgium	8,278	.....
France	11,549	20,792
Germany	13,006	6,013
Other Europe	11,455	46,143
British North America	130,016	48,256
Central American States and British Honduras	32,258	33,594
Mexico	91,410	118,626
Cuba	39,947	14,453
Argentina	32,865	15,458
Brazil	148,342	61,453
Other South America	31,253	3,010
Chinese Empire	.....	10,362
British East Indies	.....	22,666
Japan	28,748	63,987
British Australasia	5,774	30,666
Philippine Islands	15,098	.....
British Africa	7,497	15,713

Occupation Tax Ordinances Sustained.

The Nebraska courts have sustained the occupation tax ordinances of the city of Lincoln as applied to the Traction Company and the Nebraska Telephone Company. In the traction case the court reaffirmed an opinion formerly given in the telephone case. In the telephone case the court refused to grant a rehearing.

The Traction Company has fought the occupation tax ordinance since it became a law on January 1, 1907. The principal objection raised by the Traction Company was that it had to pay five per cent on its gross receipts and that the same ordinance permits the city to credit the Citizens' company upon the occupation fund with whatever per cent that company agreed to pay in return for its franchise. For the franchise the Citizens' company paid $1,000 and was to pay one per cent on gross receipts for fifteen years and two per cent thereafter.

Developments in Brazil.

A despatch from Rio de Janeiro states that the Rio de Janeiro Tramway Light and Power Company has voted to increase the stock from $25,000,000 to $40,000,000. The company, it is said, has secured control of the Ferro Caril de Jardin Botanico, or the Botanical Gardens Railway, which owns, it is stated, seventy-five miles of line and about 350 cars. The London Stock Exchange has listed $6,000,000 five per cent fifty-year mortgage bonds of $500 each.

TESTING OF TRANSFORMERS IN CENTRAL STATIONS.

BY OMER F. DUBRUIEL.

The static transformer, while in mechanical make-up one of the simplest of electrical devices, is theoretically very complicated.

In nearly all publications issued for the benefit of central-station operators, relative to transformers, the matter is presented in a too complicated form to be made of practical use and be appreciated by the central-station operator. It is the object of this article to present in a simple manner methods of testing which will assist central-station operators in testing out transformers of any make, so that they can determine their relative value and performance.

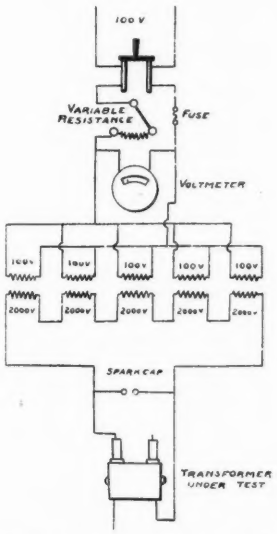


FIG. 1.—INSULATION TEST, 10,000 VOLTS, USING FIVE TRANSFORMERS.

The tests are classified under three heads: 1. Tests to determine condition. 2. Tests to determine performance. 3. Test to determine capacity.

Tests to determine condition are: Insulation breakdown test from primary to secondary; insulation breakdown test from primary to iron; insulation breakdown test from secondary to iron; double or triple potential on the winding.

Tests to determine performance of transformers are: Measurement of core loss and exciting current; measurement of impedance volts and watts; ratio of transformation; polarity; regulation.

The test to determine capacity of transformer is the heat run.

INSULATION TESTS.

All makes of standard transformers, that is, transformers designed to operate on circuits of approximately 1,100 or 2,200 volts primary and 110, 220 or 440 volts secondary, should withstand for a period of five minutes a difference of potential of 10,000 volts (alternating current) between primary and secondary, and 10,000 volts between primary and core, and 5,000 volts between secondary and core, and also withstand a no-load run at triple potential for one-half hour either on primary or secondary winding. (A. I. E. E. Standardization Rules.)

The triple potential test should be made on a circuit of 125 cycles or more, as this test made on low-frequency circuits is harmful to the transformer, due to the heavy exciting current.

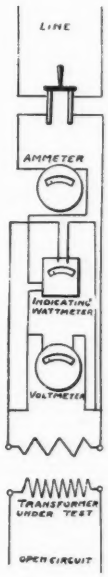


FIG. 2.—TESTING FOR CORE LOSS AND EXCITING CURRENTS.

It is desirable when making the insulation test between primary and secondary and between primary and core to have all leads of each winding together and also to ground the secondary winding to the core.

In making the above tests it is advisable to have a special transformer wound for 10,000 volts; but where this is not to be had the test can be made by using five transformers, each of approximately 2,000 volts primary, as shown in Fig. 1. Care should be taken to bring the voltage up gradually on the 110-volt side of the transformers, as there is a potential difference of 10,000 volts on the end transformer between the primary and secondary windings. This method should be used only when the testing transformer cannot be obtained.

The spark-gap indicated in Fig. 1 should be adjusted according to the curve of Fig. 14. After the adjustment is made and the sparking distance is attained between the new needle points, which must be used at every discharge, the power can be shut off and the spark-gap increased ten per cent above the distance given in the curve, after which the voltage should be brought up to the former adjustment, as shown by the voltmeter in Fig. 1. The spark-gap, therefore, will not discharge unless the desired voltage has been exceeded by ten per cent, and in that case will serve to protect the transformer from excessive strain.

LOSSES.

The losses that take place in a transformer are the core loss and the copper loss.

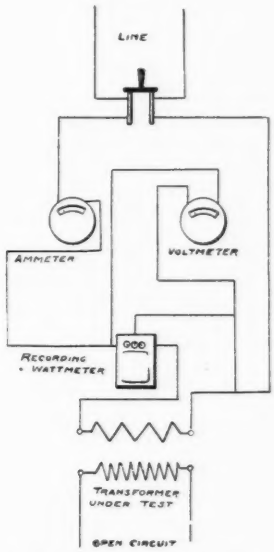


FIG. 3.—RECORDING WATTMETER USED IN TESTING FOR CORE LOSSES.

The core loss consists of the hysteretic loss, due to cyclic reversals of the particles of iron composing the core, and the eddy current loss, due to short-circuited currents generated in the core.

Testing for Core Loss and Exciting Currents.—The core loss is taken at the normal voltage of proper frequency, impressed across the low-voltage terminals of the transformer under test. Fig. 2 is a diagram of connections for this test. The wattmeter indicates the core loss, and the ammeter the exciting current.

If no indicating wattmeter is available for this test a recording wattmeter may be used by connecting as shown in Fig. 3. This wattmeter should be of the same voltage as the transformer under test and of sufficient capacity to carry current as indicated by the ammeter. A five-ampere meter will usually be the best suited for transformers up to and including fifty

kilowatt capacity. The core loss of a five-kilowatt transformer will be about forty-six to forty-eight watts.

In connecting the wattmeter, care must be taken to install it exactly as instructed by the maker of the instrument. For example, take the Fort Wayne Type K wattmeter with 110-volt, sixty-cycle, sine wave impressed across the secondary terminals; the meter disc will make five revolutions in 93.5 seconds.

The following formula may be used to obtain the core loss in watts:

Revolutions of disc × constant marked on the meter disc × 3,600 =

Seconds required to make these revolutions.

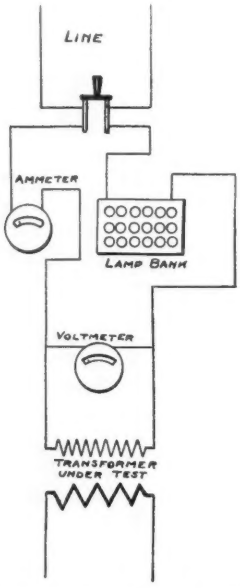


FIG. 4.—DETERMINING THE RESISTANCE BY FALL OF POTENTIAL METHOD.

The greater the number of revolutions the more accurate the results will be. Several readings should be taken, and the average used to correct the readings.

Testing for Copper Loss by Resistance Method.—When the resistances of the primary and the secondary coils are known, the copper loss may be calculated for any load on the transformer. Probably the best method of determining the resistance is by the fall-of-potential method, as shown in Fig. 4, using direct-current instruments and either storage batteries of a sufficient capacity or a direct-current generator. In this method the current I and the voltage E are observed, and the resistance R calculated from Ohm's law, $R = \frac{E}{I}$.

The copper loss is the sum of the I^2R losses of both primary and secondary windings.

The current for any transformer may be calculated as follows:

$$\text{Current} = \frac{\text{Capacity of transformer in watts}}{\text{Rated voltage}}$$

For example, in a five-kilowatt transformer rated 1,100/2,200 volts primary and 110/220 volts secondary, the full-load current in a 2,200-volt primary connection will be $\frac{5,000}{2,200} = 2.27$ amperes, and the secondary current in a 220-volt connection will be $\frac{5,000}{220} = 22.7$ amperes.

Assuming the primary resistance to be eight ohms, and the secondary resistance

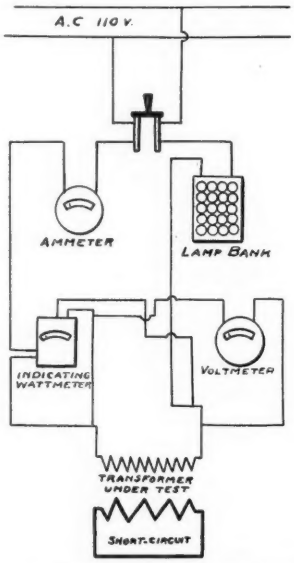


FIG. 5.—TESTING FOR COPPER LOSS BY WATTMETER.

to be 0.09 ohm, the copper loss by resistance will be, in the

Primary.....$2.27^2 \times 8.$ = 41.2 watts
Secondary ....$22.7^2 \times .09$ = 46.4 watts

Total .....87.6 watts

Therefore, the copper losses at full load on a five-kilowatt transformer are approximately eighty-eight watts.

Testing for Copper Loss by Wattmeter.—The copper loss, as determined by the wattmeter method, includes eddy-current losses due to the cutting of the windings by the leakage flux; therefore, the copper loss by wattmeter will be slightly higher than the I^2R loss measured by the fall-of-potential method in a well-designed transformer. When the conductors are not sufficiently subdivided, the eddy currents in the same will be very large.

If to the copper loss be added the constant core loss, the total losses and the efficiency losses may be determined for each load.

The connections for this test are shown in Fig. 5. It should be made preferably on the primary side with secondary winding short-circuited and with full-load current in the windings. Care should be taken in short-circuiting the secondary to have as good contacts as possible, and connecting cables as short as possible. A recording wattmeter may be used for this test by the same method as that described under core loss.

Testing for Impedance.—The impedance of the alternating-current circuits corresponds to the resistance of direct-current circuits, and is frequently expressed in impedance volts. The im-

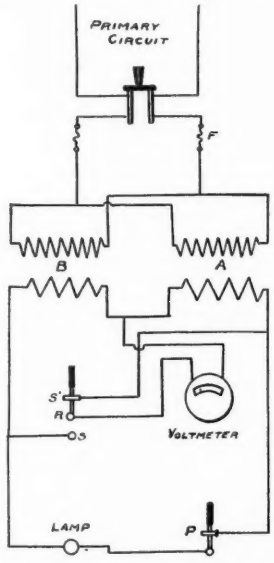


FIG. 6.—CONNECTIONS FOR MAKING RATIO TEST.

pedance voltage of a transformer is the pressure required to force full-load current through either winding with the other short-circuited.

The impedance volts may be measured by a voltmeter connected as shown in Fig. 5. This voltage should be measured with full-load current flowing in both primary and secondary.

The impedance voltage varies from two to six per cent of the rated primary voltage of the transformer under test. Where there is no variable resistance to be had, as shown in Fig. 5, a simple method of obtaining the percentage of impedance is as follows:

Short-circuit the secondary of the transformer through an ammeter (which should be of sufficient capacity to take care of at least 200 per cent of secondary full-load current), and to the primary winding apply the pressure of 110 volts

alternating current. Both windings should be connected for their highest voltage in this test.

The impedance will then be:

$$\frac{\text{Pressure applied to primary winding}}{\text{Rated primary voltage} \times \text{per cent of load shown by ammeter}} = \text{per cent impedance.}$$

RATIO AND POLARITY TESTS.

Before a transformer is put into service it is well to make sure that the ratio and connections are correct. The ratio should be absolutely correct, otherwise the delivered voltage will be either too high or too low, causing short lamp life or low candlepower. Correct ratio is essential in multiple connection of transformers, otherwise cross-currents will exist, causing undue heating, and eventually the burning out of some of the transformers.

To make the ratio test (Fig. 6), see that the small switch P, controlling the

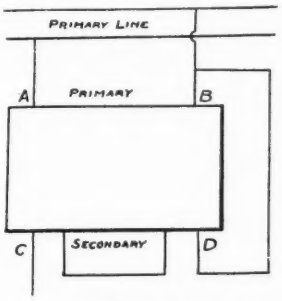


FIG. 7.—CONNECTION FOR POLARITY TEST.

lamp, is open, then close the secondary switch R first to S, then to S'. If the transformers are of equal ratio, then the two voltages will be the same.

The correct polarity of a transformer is always another condition which must be taken into consideration when connecting two or more transformers in parallel. In speaking of transformers having the same polarity is meant that the instantaneous direction of currents in the leads joined must be the same.

A transformer whose exact ratio and polarity are known should be available in making the following tests: Referring to Fig. 6, A is the transformer under test, and B a transformer of standard ratio and polarity.

The secondaries of the two transformers are connected in series, and to their common connection, one terminal of the voltmeter is connected, the other voltmeter terminal being connected to the central point of the single-pole, double-throw switch. One or more incandescent lamps in series, whose combined voltage is equal to the total voltage of the two secondaries, are connected across the secondary leads of the transformer to determine the polarity.

To make the polarity test, see that the secondary switch R is open, and the small switch P. is closed, putting the lamps in circuit, then close the main switch, and if the lamps light up, the polarity of the two transformers is the same.

If no standard transformer is to be had, another easy method of making ratio and polarity tests is as follows:

The ratio can be determined by simul-

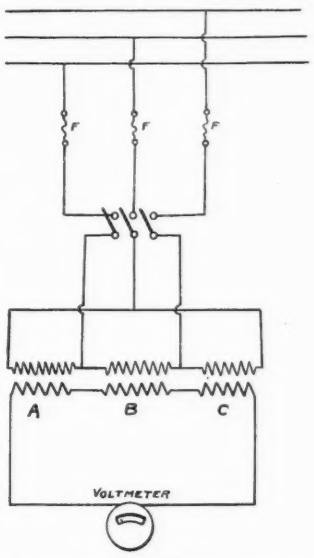


FIG. 8.—METHOD OF TESTING FOR POLARITY, WITH THREE-PHASE CURRENT.

taneous readings of the primary and secondary voltage of the transformer under test at no load. To read the primary voltage, a potential or standard transformer of ten or twenty to one ratio may be used to step down the voltage to get within the range of a standard voltmeter. To get an accurate determination of ratio this test can be made only with carefully calibrated instruments.

The polarity test is indicated in Fig. 7. The leads of the transformer are brought out so that when B and D are connected together, a continuous winding is formed from A to C, including all primary and secondary coils. Therefore, if the given voltage is impressed at AB, the voltage at AC will be greater than the impressed voltage if the leads are brought out properly, and less than the impressed voltage if improperly brought out.

Another method of testing polarity, where three-phase current is available, is as follows: Assuming that a high-voltage, three-phase supply is available, the primaries of the three transformers will be connected in delta, as shown in Fig. 8. The secondaries will be connected up in delta with a voltmeter capable of withstanding twice the secondary voltage of one transformer. If the three transformers are all of the same polarity, then the potential difference across the voltmeter will be zero. If the polarity of any one of the three transformers differs from the other two, then the potential difference across the voltmeter terminals will be twice the voltage of one transformer.

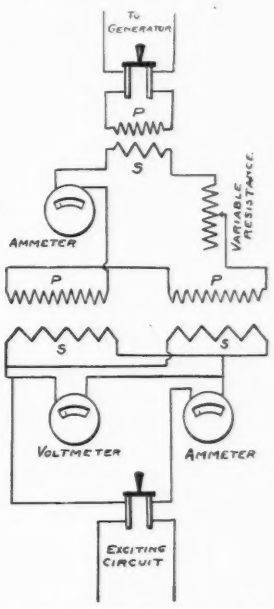


FIG. 9.—HEAT TEST BY OPPOSITION MEHOD.

If low-voltage, three-phase current only is available, then the secondaries should be connected in closed delta on the three-phase circuit, and the primaries connected up in delta with one leg open-circuited. There should be inserted in this one circuit an auxiliary transformer to step down to suitable voltage for the voltmeter, as in the event of one transformer being of the wrong polarity, the voltage will then be twice the primary voltage; it is therefore necessary to protect the voltmeter against burnout, and this can be done by using a step-down transformer of known ratio and connecting the voltmeter to its low-voltage side.

HEAT TEST.

The temperature at which a transformer operates is the factor which limits its output and affects its life and efficiency. High operating temperature causes deterioration of insulation, increased core loss, due to aging of the iron, and increased copper loss, due to increased resistance of copper.

The American Institute of Electrical

Engineers recommend that the temperature rise of transformers for continuous service shall not exceed fifty degrees centigrade, as determined in the electric circuits by resistance, and in all other parts by thermometer.

To obtain the temperature rise the transformer is operated with full-load current of proper frequency until the temperature shall have become constant. There are two general methods of obtaining full-load current.

First Method.—The transformer may be connected to a circuit of proper voltage and frequency and full-load current obtained by loading the secondary with lamps or other resistances.

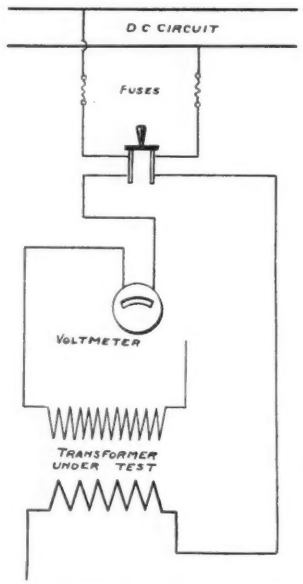


FIG. 10.—METHOD OF MAKING INSULATION RESISTANCE TEST.

The energy in kilowatt-hours required for this method equals the kilowatt capacity of the transformer multiplied by the time of test in hours. As the energy required for a transformer of three to five kilowatts capacity or over would be very large, this method is not used except with transformers of the smallest size.

Second Method.—This method is known as the "loading-back" or "opposition" method or "method of pairing," and has the advantage in that no energy except that to supply the copper and core losses is necessary. Therefore this method may be used with transformers of large kilowatt capacity, with very little energy consumption.

Two transformers having the same voltage and ratio and as near the same kilowatt capacity as possible are required for this test. The secondaries are connected in parallel (as shown in Fig. 9) and excited from a circuit of proper voltage and frequency, thereby inducing normal voltage in each primary; the two primaries are connected in series, but in opposition, thus making their combined voltage zero.

As each transformer is in effect short-circuited by the other, it follows that approximately the sum of their impedance voltages applied across the primaries will impress full-load current in both primary and secondary windings. This impressed voltage may be obtained from a small auxiliary transformer having a lamp bank or other suitable resistance in series with the coils, by which the voltage may be adjusted until full-load current flows in both windings.

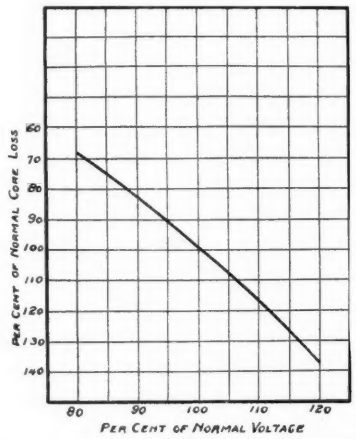


FIG. 11.—RELATION OF CORE LOSS AND VOLTAGE.

Before commencing this test the transformer should be filled with oil and left in the room in which the test is to be made long enough to attain the same temperature as the room. Three accurate thermometers are necessary for this test, one to be suspended in the room, one in the oil in the transformer case, and one with its bulb secured to and in contact with the outside of the transformer case by putty.

The procedure is to record temperatures as shown by the thermometers and to measure resistances of primary and secondary, as under copper loss; record thermometer readings every half hour and resistance of primary and secondary alternately every half hour. The primary and secondary temperature rise must be figured from their respective readings.

The temperature rise of the windings may be determined from their respective readings by the following formula:

$$\frac{\text{Resistance hot} - \text{resistance cold}}{\text{Resistance cold}} \times 250 = \text{temperature rise in degrees centigrade.}$$

The core loss, exciting current, and copper loss should be determined before and after the heat run. The copper loss will be greater at the end, due to increased resistance at the high temperature.

The core loss and exciting current should be less at the end of the test than at the start; if this is not the case, the transformer is either not well insulated or is not thoroughly dried out. If the core loss increases instead of decreases at the end of the run, it would be well to measure the insulation resistance to determine the condition of the insulation.

The insulation resistance of a well-insulated transformer thoroughly baked out should be not less than one megohm from primary to secondary, or from primary or secondary to ground. Fig. 10 shows the method of making the insulation resistance test. The supply voltage may be any voltage from 110 to 550 volts direct current; the voltmeter should have sufficient range to measure the supply voltage.

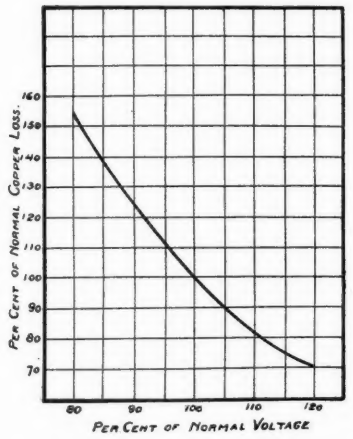


FIG. 12.—RELATION OF COPPER LOSS AND VOLTAGE.

Insulation resistance is the total line voltage less the voltmeter reading between winding and ground or between primary and secondary, multiplied by the resistance of the voltmeter, and this result divided by the voltmeter reading between the winding and ground or between primary and secondary will give the insulation resistance in ohms.

REGULATION.

The regulation of a transformer is the per cent increase of the secondary terminal voltage as the load is decreased from full load to no load. This test should be made by observing the voltage at the secondary terminals of the transformer, at full load and no load, the primary voltage and frequency being held constant at all times.

The regulation expressed in per cent

will be the difference between the full-load and no-load readings divided by the rated secondary full-load voltage of the transformer and multiplied by 100.

EFFICIENCY.

The efficiency of a transformer is the ratio of its net power output to its gross power input, the current being measured with non-inductive load. The power input includes the output plus the core loss and the I^2R loss of both primary and secondary windings at a given load on the transformer.

The copper loss as found by a wattmeter may be used instead of the calculated I^2R loss in calculating the efficiency.

For example, we will take a five-kilowatt, sixty-cycle, 1,100/2,200 volts primary, 110/220 volts secondary transformer.

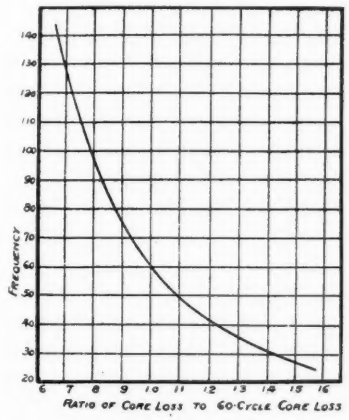


FIG. 13.—RELATION OF CORE LOSS AND FREQUENCY.

Primary, 2,200-volt connection, 2.27 amperes.
Secondary, 220-volt connection, 22.7 amperes.
Resistance of primary, eight ohms.
Resistance of secondary, .09 ohm.

Losses Full Load.—

Primary I^2R, 41.3 watts.
Secondary I^2R, 46.4 watts.
Total I^2R, 87.7 watts.
Core loss (which is constant), forty-eight watts.
Total loss, 135.7 watts.
Output at full load, 5,000 watts.
Input at full load, 5,135.7 watts.

$$\text{Efficiency} = \frac{5{,}000}{5{,}135.7} \times 100 = 97.35 \text{ per cent.}$$

Losses Half Load.—

Total I^2R ($= \frac{1}{4}$ of full-load I^2R loss), 21.9 watts.
Core loss, forty-eight watts.
Total loss, 69.9 watts.
Output, 2,500 watts.
Input, 2,569.9 watts.

$$\text{Efficiency} = \frac{2{,}500}{2{,}569.9} \times 100 = 97.3 \text{ per cent.}$$

All-Day Efficiency.—The all-day efficiency of a transformer is the ratio of the output to the input during twenty-four hours.

Taking the same transformer as above, with full load for two hours; half load for two hours; quarter load for two hours, and one-tenth load for eighteen hours, the all-day efficiency is determined as follows:

Full Load.	Output in Watt-Hours.	I^2R Loss.
	10,000	174.5
½	5,000	43.8
¼	2,500	11.0
1/10	9,000	15.8
	26,500	245.1

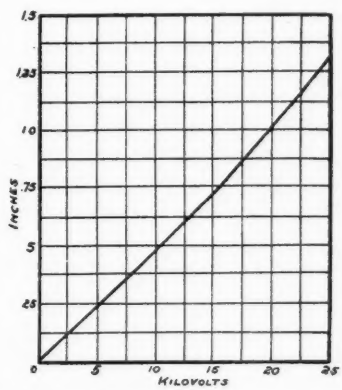


FIG. 14.—RELATION OF SPARK GAP AND VOLTAGE.

Core loss for twenty-four hours, $48 \times 24 = 1{,}152$ watts.
Total loss for twenty-four hours = 1,152 watts + 245 = 1,397 watts.
Total output for twenty-four hours = 26,500 watts.
Total input for twenty-four hours = 27,897 watts.

$$\text{All-day efficiency} = \frac{26{,}500}{27{,}897} \times 100 = 95 \text{ per cent.}$$

OIL FOR TRANSFORMERS.

The oil used in transformers performs two important functions; it serves to insulate the various coils from each other and from the core, and it conducts the heat from the coils and core to some cooler surface, namely, the transformer case, where it is dissipated in the surrounding air.

It is evident that the oil should be free from any conducting material. It should be sufficiently thin to circulate rapidly when subjected to difference of temperatures at different places, and it should not be ignitible until its temperature is raised to a very high value.

A good grade of transformer oil should show very little evaporation at 100 degrees centigrade; it should not give off gases at such a rate as to produce an explosive mixture with the surrounding air at a temperature below 180 degrees; it should not contain moisture, acid, alkali or sulphur compounds.

It has been shown that the deteriorating effect of moisture on the insulating qualities of an oil is very marked. Moisture to the extent of 0.06 per cent reduces the dielectric strength of the oil to about fifty per cent of the value it has when free from moisture, but there is very little further decrease in the dielectric strength with an increase in the amount of moisture.

Dry oil will withstand a breakdown test of 25,000 volts between two 0.5-inch knobs separated by 0.15 inch.

The presence of moisture can be detected by thrusting a red-hot nail into the oil; if the oil "crackles," water is present.

Quick Telephone Service.

The number of telephone calls that can be answered in a few minutes in a well-equipped office, as well as the importance of news for Wall Street, was recently well illustrated.

All the private wires to Washington, all the press associations and other news services, except one, announced that the government had won the day of the decision in the famous commodities case. The latter "flashed" the news that the railroads had won.

This firm stood by their announcement, and details of the decision soon rallied prices and sent Reading above 150.

In the ten or fifteen minutes of Wall Street's uncertainty, however, the telephone switchboard of the firm that had the correct information received between 200 and 300 calls of inquiry, to every one of which there was only time to give the unqualified reply: "The Railroads Win."

It is probable that never before in telephone history were so many telephone calls answered in so few minutes.

Platinum Drops $1 an Ounce.

A decline of a dollar an ounce in the price of platinum, which is used extensively in the electrical field, for the manufacture of high-grade mountings for diamonds and other precious stones, and for laboratory apparatus is reported.

A NEW SYSTEM OF WIRELESS TELEGRAPHY USED BY THE TELEFUNKEN COMPANY.

BY COUNT ARCO.

After it had been discovered that by means of the Poulsen arc it was possible to generate undamped oscillations of considerable energy, several scientists, especially those of a theoretical turn of mind, were inclined to lay too much stress on the advantages of this system, and the opinion was expressed in several quarters that undamped oscillations obtained from arc lamps would replace the other methods of generation within quite a short time. Practical men spoke against this enthusiasm, and drew attention to the numerous disadvantages present in the new system. Today, scarcely three years after this period, it cannot be denied that the warning of the practical men was justifiable, and that the disadvantages of the arc lamp are even greater than the greatest skeptics thought. Not only from the practical point of view has the system been found disadvantageous, on account of the heavy upkeep and the many complications, but from a purely electrical point of view as well the position is the same. Of the energy generated at the sending end only a small fraction—at most one-tenth—is converted into electrical oscillations. For this reason both apparatus and machinery must be large and heavy. Moreover, the theoretical advantage—great freedom from disturbance from other stations and from atmospheric effects—is not obtained in practice.

Within the last year the Telefunken Company has designed a new system which is a compromise between the spark system of Marconi and that known as the undamped oscillation system. This new system is known as the "singing spark" (tönende Funken) system.

As regards the technical peculiarities of the new system, it may be said that it depends on spark methods, which in themselves depend on the principle published in December, 1906, by Prof. Max Wien and called by him "Stosserregung." This name has been changed by the Gesellschaft für Drahtlose Telegraphie to "quenched spark" (Löschfunken). This principle has been so perfected by the company that the sparks follow each other equally and regularly; so regularly, in fact, that they give out a queer musical tone, and to this system the name of "singing spark" has therefore been applied.

The first two types of station constructed by the company are: (1) A ship or land station having a capacity of from one-half kilowatt to two kilowatts, and suitable for both large and small ships as well as for portable military stations. It has a radius of action of 62.5 to 500 miles both to land stations and ships. (2) The largest ship station at present erected, having a capacity of from eight kilowatts to ten kilowatts. With this type it will be possible with standard ship antennæ, under favorable conditions, to transmit 1,875 miles, a distance which has never before been reached from ship to ship. The same station is also suitable for work on land with correspondingly larger antennæ.

The practical and technical advantages of the new system over the older spark methods, as well as over the undamped arc oscillations, are summarized as follows:

Singing sparks allow the work to be carried on with considerably smaller antennæ than do the usual wireless systems. The reason for this lies in the speed with which the sparks follow each other in the secondary circuit, thus making it possible to transmit greater power from the antennæ at a smaller maximum voltage than formerly. For this reason the new system is specially suitable when it is necessary to transmit over long distances with small antennæ. Theoretically this should also be the case when arc lamps are used, as for a given amount of energy the voltage lost in the antennæ is a minimum. Practice, however, has shown that with arc-lamp installations the maximum height of mast must be employed, say from 300 feet to 330 feet, while with the new system the same distance can be covered with masts about half this height. The reason for this contradiction between theory and practice is explained by the fact that the nominal oscillation energy from the arc lamp can be generated only when the wave length is very great, which means high antennæ. On the other hand, singing sparks work as well with the smallest as with the greatest wave lengths.

Singing sparks allow a high machine efficiency to be obtained, for, according to the size and suitability of the apparatus, from fifty to seventy-five per cent of the machine output can be changed into energy at the antennæ. With the old spark systems the maximum figure was twenty per cent, and in the arc lamp arrangement ten per cent. In places where current for working the station has to be specially generated, this superiority obtained by using singing sparks will lead to a considerable decrease in the working costs. Further, it is specially advantageous where questions of weight and volume have to be considered, since in small ships and portable stations with this system the power and weight for an equal range is only about a quarter that needed for arc-lamp stations. On account of this great efficiency another advantage arises. The wear and breakdowns of the apparatus are small, because of the small heat losses present, while regulation of the spark length, or of any other important part, of the new sender is hardly ever necessary. On this point Dr. Kiebitz has remarked that "in the singing spark system we may have a final solution to the problem of high frequency generation."[1]

With the new system it is possible to build senders as large as may be desired without any such limitations (e. g., in the wave length) or difficulties (e. g., in the constancy of the oscillations) as occur when a large amount of energy is transmitted. The new system behaves quite like the spark method, in which power as great as 100 kilowatts can be transformed into oscillations (though at a very low efficiency). It works better than the arc method of generation, for in this system if a large amount of energy is used, there not only is excessive damping on the long wave lengths, but irregularities of many kinds creep in, because at very high voltages and currents an arc lamp is unsteady and the great development of heat gives rise to a rapid burning away of the electrodes. As, moreover, these inconstant conditions in the arc have an influence on the frequency the system is put at a still further disadvantage. Such alterations are much more likely to occur at large stations, and it has been up to date impossible to install this method of working for plants of large size.

The sender in the singing spark system is almost as noiseless in its working as is the arc lamp.

The sender transmits only one wave, and is thus different from the spark sender, which transmits two coupled waves. This fact marks a great step forward, as the receiver is able to utilize the total sender energy, and, owing to the disappearance of the two coupled waves, multiple telegraphy is made much more easy. Under such conditions numerous stations can work undisturbed close to each other.

The wave sent out by the singing spark shows a very small damping, viz., between 0.08 and 0.025, thus enabling a very sharp tuning and great freedom from disturbance in the receiver to be obtained. The freedom from disturbance may, according to circumstances, be much greater than that obtained with undamped oscillations. It varies, under conditions to be hereafter described, from two to five per cent.

These singing oscillations remain absolutely constant, and are independent of the arrangement and mechanical properties of the spark gap, and very much greater freedom from disturbance can be obtained than with the arc lamp. In the latter the greatest freedom is theoretically from one-half to one per cent, because the frequency does not depend upon the

[1] See *Elektrotechnische Zeitschrift*, 1909, No. 10.

electric constants of the circuit alone, but on the arrangement, length and properties of the arc. So long as the principle of generating undamped oscillations has to depend for its frequency on so variable a value as an arc lamp, ideal freedom from disturbance will never be obtained. In spite of the control of the resonance by means of a wave measurer, the frequency of the arc lamp alters, and a choice has to be made at the receiving end between a highly untuned receiver, whose intensity constantly varies so that certain telegraphic working is difficult, and a receiver very slightly free from disturbances, in which the total employment of the resonance is renounced, so that the range is reduced. Arc-lamp practice requires that the latter method should be chosen. The real freedom from disturbances of undamped waves reaches only five to six per cent, and even this, from the fact which we mention below, is seldom obtained in practice. The freedom from disturbances of two to five per cent obtained with singing waves may be understood by considering the following example: At the three angles of an equilateral triangle, ABC, three stations of equal power are placed, A and B being fitted with senders and C with a receiver. C can then, as desired, receive from A or from B when these have a difference of wave length of only five per cent. This condition depends on the fact that the distance apart of the three stations is as great as possible for the energy available, so that the telegrams will not arrive at C with very great intensity. If the distance apart of the three stations is reduced to one-half that mentioned above, the senders at A and B can be made different by three per cent instead of five per cent, or by still smaller differences if the distances are still further altered. When speaking of freedom from disturbances, it is understood that the percentual differences which must necessarily be present at the maximum range are included.

Singing sparks allow a large scale of oscillations to be obtained, while with the old spark stations only certain fixed waves could be sent out; and, on account of electrical resonance, the scale of waves could only differ from the fundamental of the antennæ by about double the wave length. It is possible with this new system to obtain oscillations of wave lengths four, five, and even six, times as long as the fundamental, though the range gradually decreases. This new system behaves exactly like the arc-lamp system, except that the singing oscillations have the advantage that antennæ with very small fundamentals can be used, while with arc lamps these large scales of oscillations can only be employed with very high masts and long antennæ. The generation of the different oscillations can be obtained on the new system in a very simple way by using the regulating arrangement known as a variometer, and without the use of a wave measurer being generally necessary.

As mentioned in the previous paragraph, the system allows very short oscillations to be transmitted. Short oscillations are, however, more absorbed on the way, though this apparent disadvantage is often a very great advantage from the military point of view. Suppose a message is sent with very short oscillations to a station fifty kilometres away, and is received with great intensity. The enemy at a distance of, say, 100 kilometres, would scarcely be able to pick up anything, even with the most delicate instruments, while the behavior of longer waves is quite different. Over open country, distances of over 200 kilometres to 300 kilometres can be covered by these waves, and they possess the advantage that a listener a little further off cannot understand anything. It is further possible, by using quite short waves, to remove the instrument from the operation of large stations which only work with long waves. The use of short waves, also, predicates an extraordinarily high antennæ efficiency, as, on account of the more speedy transmission of energy with short waves, the maximum energy for a given antennæ can be increased.

The system of singing sparks allows under all circumstances, unlike the arc lamp, full freedom from disturbance, as the intensity of the oscillations can be regulated in a most simple fashion between wide limits. Even with a station having a range of several thousand kilometres, the intensity can be so reduced that telegrams will only be heard over a distance of 100 kilometres, and, further, "tapping" by unauthorized persons is made very difficult and the freedom from disturbances is greatly increased. Take, as an example, that given above. Suppose the range of a sender, say, at B, to be reduced to one-hundredth of the distance from B to C, a five per cent freedom from disturbance will become, perhaps, thirty per cent if B does not reduce its sending intensity. To do this is quite possible with the new system, while regulating an arc lamp on a small current leads to an unsteadiness of the flame and makes the apparatus work badly. It is, therefore, not very correct to speak of a freedom from disturbance of five per cent with the arc lamp when in many cases a freedom from disturbance of only twenty to thirty per cent is really obtained.

Perhaps the greatest advantage of the new singing spark is the fact that the signals are transmitted as clear musical tones. Musical sparks have already been often proposed and also partly developed, but the tone cannot be made clear, and only by the absolute clearness and regularity of sound were the above results obtained with the new system. With audible working from the old spark stations the signals in the telephone were received as ticks. Each time the spark passed the membrane moved, while with the arc lamp similar noises were also obtained. Similar phenomena are noticed with atmospheric discharges in receivers at these stations, and with this arrangement the working was often disturbed in spark stations; but the conditions were much worse in arc stations, as the noises from atmospheric disturbances are very much like those given by the latter type of working. It is, however, quite different when receiving the sound from the musical-spark system. However numerous and strong the discharges may be, an even slightly skilled telegraphist can distinguish them by their singing tone. The sound, if it is truly musical, can be clearly heard, even if it is very weak. It may be said that for the first time since the invention of wireless telegraphy a system has been obtained which enables telegraphic work to be carried on through the heaviest atmospheric disturbances, and up to the limit when the detector would break down under the atmospheric discharge.[1] The use of a particular tone gives the sender a certain individuality. Turning again to the three stations at the corner of a triangle, it may be supposed that station A gives a sound with a frequency of 500 per second, and B one with a frequency of 1,000, so that C can receive telegrams at the same time to both stations quite separately with only one antenna, a receiving apparatus, a detector, and only when the two senders are transmitting oscillations of nearly the same wave length need two operators be present, one of whom writes down the telegram with the higher sound and the other the one with the lower. By this means great simplicity in working and quite considerable freedom from disturbances are obtained. It is no longer necessary to tune the receivers for multiple telegraphy, for it often occurs with this arrangement that the sender for which the receiver is not tuned begins to work. To prevent this danger a suitable working rule has not yet been found. Electrical tuning, by using a long wave scale, can also be obtained, and by this method not only two, but a great number of stations can work without disturbance from each other.

The system of singing sparks allows an acoustic tuning of the receiver to be obtained by the use of clear musical tones, while these, as shown under the last paragraph but one, depend on the selective capacity of the human hearing, so that certain parts—for instance, parts of a so-called sound intensifier—can be imposed on the frequency of the sounds received, and prevent senders of other sounds, impulses from ordinary spark stations and especially atmospheric disturbances from interfering.

As to a receiver for this new system, all the well-known acoustic receivers can be used, and no "Ticker" is necessary at the receiving end. In spite of this, a new receiver has been designed for all sizes of stations, which both in construction and in electrical arrangement does not differ considerably from the present type of receiver. A special receiver has also been designed which, as a result of a number

[1] See *Elektrotechnische Zeitschrift*, 1909, No. 10.

of measurements, has been shown to be capable of receiving over a large scale of wave lengths, from 200 to 3,000 metres, with a very small loss from damping in the tuning arrangements. The operation of the rectifying detector, working on the principle of the contact detector, is very sensitive, being about twenty per cent more sensitive than the electrolytic type. It is also very constant, and is not disturbed either by atmospheric discharges or by "over-intensity" due to neighboring or strong senders. In connection with this receiver two boosting apparatuses have been designed which employ the special advantages of the new form of musical sender. Both these apparatuses are of great practical importance. There is then the calling apparatus, which is employed instead of the telephone receiver on the standard receiver, and rings an electric bell whenever a singing sender works for over ten seconds; but for atmospheric discharges and for discharges from the usual spark sender, as well as for Morse signals, it does not ring, though the calling arrangement operates up to the limit of hearing capacity. The second apparatus is a resonance relay, which makes it possible to intensify the weakest signals while still keeping them as clear musical tones, so that they can be received in the station. Such an increase is only possible by the use of a body oscillating with mechanical resonance, and the sound must be quite clear. By the use of a relay, atmospheric disturbances are practically cut out, as single discharges only slightly influence the resonance system. Several relays of different tones make it possible to differentiate between signals from different senders which are transmitting with equal wave lengths but different notes, and differentiations to be made without the help of the human ear, which becomes tired.

The Faraday Society.

The forty-fourth ordinary meeting of the Faraday Society was held on April 27, at the Institution of Electrical Engineers, London. Dr. V. H. Veley occupied the chair. A paper entitled "Experiments on the Current and Energy Efficiencies of the Finlay Electrolytic Alkali-Chlorine Cell," by F. G. Donnan, J. T. Barker and B. P. Hill, was read in abstract by Professor Donnan.

This electrolytic cell is characterized by the use of a double diaphragm and central brine compartment, whereby the brine solution continuously flows under head from the central compartment through the diaphragm to the anode and cathode compartments, and from these to suitable outlets. By a suitable arrangement of overlapping holes and slots any number of compartments (anodic, cathodic, and brine) and corresponding electrodes can be bolted together. The various compartments are constructed by placing between the diaphragms thin rectangular or square frames of waxed cardboard about two to three millimetres thick. The various layers of electrolyte are therefore simply thin sheets of liquid, so that the electrical resistance per square foot of electrode surface is reduced as much as possible. The anodes consist of rods or slabs of Acheson graphite, the cathodes of sheet iron. The counter-flow of electrolyte greatly aids in reducing the loss of efficiency caused by electrical migration of the hydroxyl ions toward the anode, and by diffusion and convection of dissolved chlorine to the cathode.

The experiments described in the paper were carried out with small laboratory models suitable for ten to twenty amperes, and had as their object the determination of the current and energy efficiencies of the cell. The experiments show that it is possible with the Finlay cell to make very much stronger alkali at much higher current and energy efficiencies than in single-diaphragm cells with non-percolating electrolyte. So far as published data go, the results obtained with the Finlay cell appear to be superior to those obtained with the Aussig "bell-jar" process, especially with regard to energy efficiency. A comparison with the results obtained with the Townsend cell is difficult, for want of sufficient data, but it is believed that the Finlay cell would not be likely to suffer from such a comparison.

Robert Finlay explained that certain disadvantages inherent in the small cell tested by the authors were eliminated in the large units. He believed that in its latest form the cell left little room for further improvement. Solutions containing eight grammes caustic soda per 100 cubic centimetres could now be made at a voltage of three from brine at ordinary temperatures, and with a current efficiency of 98.0 per cent, a yield forty per cent higher than that of the most successful electrolytic process now worked in England. One of the chief features of the cell was the absence of secondary reactions.

Dr. Charles J. J. Fox read a paper "On the Coefficients of Absorption of Nitrogen and Oxygen in Distilled Water and Sea Water, and of Atmospheric Carbonic Acid in Sea Water." These coefficients have acquired some significance of late years, especially in connection with that group of physical problems of which Arrhenius' work on the diathermancy of the atmospheric gases, and especially CO_2 and its effect upon terrestrial temperatures is typical, and again in connection with the problems concerning the dynamic processes of pelagic life.

Dr. Percy E. Spielmann read a paper "On the Electromotive-Force of Certain Platinum Compounds, with Special Reference to the Oxygen-Hydrogen Gas Cell." The author, in association with Prof. R. Lorenz, has investigated the electromotive-forces of certain platinum hydrated oxides and salts from the point of view of the latter's "Oxyd-Theorie" for the Grove gas cell. The conclusions show that it is in the highest degree likely that the electromotive-force of the oxygen-hydrogen cell, as usually constructed, is due to a definite hydrated oxide formed by the direct oxidation of the platinum electrode by oxygen in presence of the electrolyte; this substance, however, has not yet been chemically prepared. The theoretical value of 1.23 volts can only be reached at temperatures high enough to prevent hydrated oxides from forming, *i. e.*, when a true reversible cell exists.

A general discussion of this paper was participated in by Drs. F. G. Donnan, G. Senter, C. J. J. Fox, N. T. M. Wilsmore, V. H. Veley and P. E. Spielmann.

Power Development Planned.

If the negotiations that have been in progress some time between H. L. Harriman of Boston and his associates and the Lamson & Goodnow Manufacturing Company are successful, as seems probable, the waterpowers owned by the company at Shelburne Falls, Mass., will be developed to produce electricity. Engineers are now at work to find out how much power can be developed at Shelburne Falls, at the North River, where the cutlery company has a dam, and at Scott's Bridge, where a fine power can be developed. The water rights of George G. Merrill were secured a short time ago.

Tesla to Furnish Motive-Power Machinery for Vessels.

Nikola Tesla has another workable invention and has incorporated the Tesla Propulsion Company, with the principal office in New York city and a capital of $1,000,000, to manufacture motive-power machinery for vessels. The other directors are Joseph Hoadley and Walter H. Knight of New York city.

THE DESIGN OF STEAM-ELECTRIC POWER PLANTS.

BY FRANK KOESTER.

[In a previous issue (March 13, 1909) Mr. Koester discussed the location, general arrangement, building, architectural treatment and boilers in the design of a steam-electric power plant.]

MECHANICAL STOKERS.

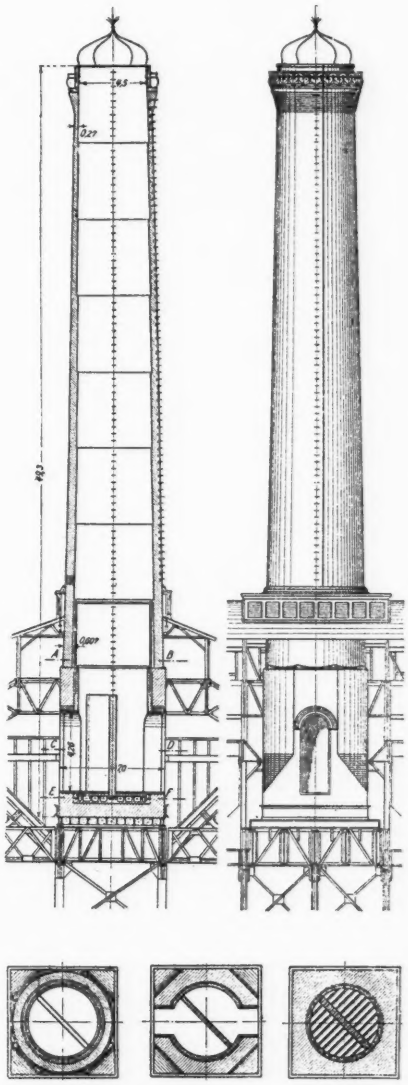
The advantages which it is desired to obtain by the use of mechanical stokers are more uniform temperature throughout the furnace and boiler setting and dispensing with the services of expert firemen; the former is undoubtedly accomplished more satisfactorily than could be done by hand firing. Where expert firemen can be had at low wages, economy in firing is, in the opinion of the writer, more easily secured by manual firing than by the use of mechanical stokers. Furthermore, the forcing of a boiler may be done by hand firing as well as by mechanical stokers. Where skilled labor of this kind is scarce the installation of mechanical stokers is recommended.

There are a number of mechanical stokers on the market, classed as underfeed and overfeed stokers. As most overfeed stokers will permit fine unburned coal to pass through the grates it is necessary in their installation to provide receptacles for gathering this fuel, which would otherwise be wasted. The practice has shown that this amounts to upward of five per cent of the amount of coal consumed, depending, of course, upon the spacing of the grate and the size of coal to be burned. It usually keeps one man busy collecting this coal for six 500 to 600 horsepower boilers. And, furthermore, a skilled man is generally necessary to attend the operation of mechanical stokers. It will thus be seen that there is still room for improvement in this class of apparatus.

Where a basement is provided the ashes are collected in hoppers, suspended from the structural steel of the boiler setting. Ash hoppers are always the source of a great deal of trouble and will probably remain so. They are made either of structural steel or reinforced concrete. When made of steel, the material used is one-fourth inch to five-sixteenths inch thick; they are sometimes lined with concrete or fire-brick to prevent the quick destruction of the hopper. Under operating conditions which require the forcing of the boiler the life of such hoppers is short, about seven to eight years being the average. The concrete lining soon cracks and the water necessary for wetting the ashes flows through these cracks, thus furthering the corrosion of the steel.

Reinforced concrete hoppers are of still shorter life, due to the excessive heat which they are exposed to and which will form cracks in the concrete structure, resulting in crumbling sooner or later.

A lining might be devised similar to the lining of a fire-door, making the hopper of perforated rolled steel plates, lined with cast-iron plates, separated from the former so as to leave an air-circulating space between the two.



RADIAL BRICK CHIMNEY, SUPPORTED ON STEEL COLUMNS.

SMOKE FLUES AND CHIMNEYS.

The flue connections between boiler and chimney must be made as direct as possible, all short turns being avoided to reduce friction. The size of the smoke flue depends upon the kind and amount of coal to be burned. The size will vary from 2.75 to 3.5 square feet of sectional area per 1,000 square feet of boiler-heating surface, the larger area providing for coal in which there is a greater amount of refuse. The areas necessary may be reduced as much as thirty per cent from those named when mechanical stokers are used. Dampers must be employed for each individual boiler, and a main damper must be employed when more than one smoke flue enters a chimney. Automatic damper regulators are essential, particularly where mechanical stokers are used or unskilled firemen are employed.

Where the runs are long and the smoke flues are made of steel, expansion must be provided for. Common brick may be used for the lining of smoke flues, it being better practice to use fire-brick, as is frequently done for lining the lower part of a chimney.

With an arrangement of the boiler room at an angle of ninety degrees to the generating room the practice is to erect a number of smaller chimneys instead of one or more larger ones. One chimney may serve for a battery of two boilers or for a group of boilers. Such chimneys are frequently carried on the structural steel of the building and are generally made of steel. However, not only steel chimneys are supported on the structural steel work of the building, but also radial brick chimneys, as may be seen in the accompanying illustration, representing a chimney of the Fifty-ninth Street station of the Interborough Rapid Transit Company, New York. The base of this chimney is sixty-three feet above the grate; the diameter at the top, which is 250 feet above the grate, is fifteen feet. The weight of the chimney is about 1,200 short tons. The platform upon which the chimney is supported is carried by six columns and is composed of seven single-webbed girders, eight feet deep, two of these girders being longitudinal and five lateral. These girders are surmounted by fourteen twenty-inch I-beams, filled with concrete, and forming a solid slab.

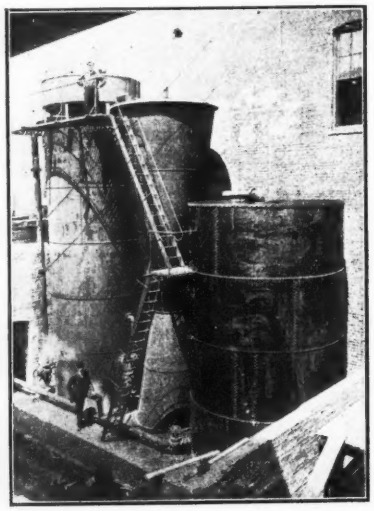
The type of chimney to be selected, whether of reinforced concrete, radial brick or steel, is largely a matter of choice, and depends practically on the cost, which again is due to the locality of the plant.

BOILER FEED WATER.

It is of vital importance that the water supplied to the boiler should be as free from objectionable substance as possible, and consequently purifiers are necessary in many localities. Boiler compounds are used for separating the objectionable sub-

stances from the water and leave the sediment in such condition that it will not form scale on the surfaces of the boiler. The best method, however, for removing all foreign substances from boiler feed water and doing away with the necessity of cleaning boilers and tubes and making repairs due to the effect of impure water is to install an efficient purifying system. The accompanying illustration shows a "Reisert" automatic water-purifying apparatus as installed at the plant of the Syracuse Lighting Company at Syracuse, N. Y. The water is taken from the Oswego Canal and varies in its character, sometimes showing a hardness of twenty-five degrees American.

After operating for some time the first purifying plant installed, a second plant



DERVOUR-REISERT WATER-PURIFYING APPARATUS. 12,000 GALLONS PER HOUR.

of like capacity (12,000 gallons per hour) was added, evidencing the efficiency of the apparatus.

An apparatus of still greater importance is a modification of the above, in which water, heated to any degree of temperature, may be purified, after a system of the Purification and Engineering Company, New York.

Feed-water heaters are of either the open or closed type and the so-called economizers. The former utilize exhaust steam for heating the water, while the economizers use the waste gases from the boiler. With the latter a higher temperature of feed water may be secured, practically as high as the temperature of the water under boiler pressure. American practice favors the use of steam-driven auxiliaries, and therefore the use of heaters is in vogue to a greater extent than in Europe, where economizers are in general use, as the auxiliaries are motor driven.

Open feed-water heaters must be placed at least three feet above the suction valves of the pump, while hydrostatic pressure is necessary where hot water is to be pumped. One of the most efficient types of open feed-water heaters is the "Cochrane," particularly in its function of removing oil from the water of condensation. These heaters are built in horizontal and vertical types and are frequently of such size as to serve as storage tanks. Open heaters may be built of any size, the size not being limited as in closed heaters by the amount of pressure carried.

No matter what type of feed-water heater may be installed, the theoretical efficiency and the percentage of gain resulting from the increased temperature of the feed water is figured by the following formula:

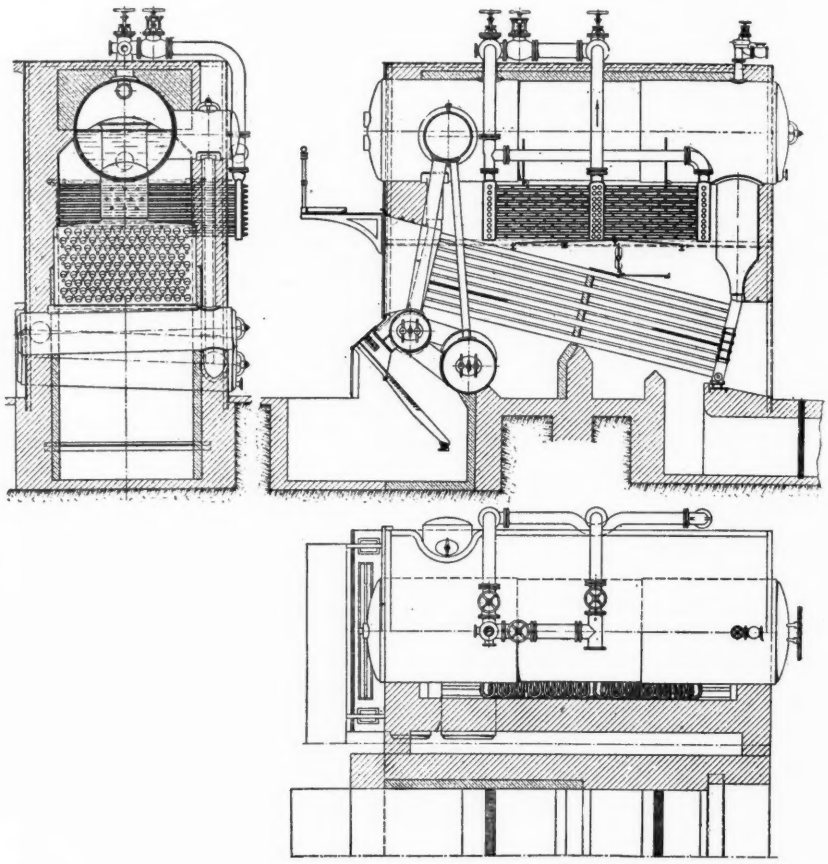
$$\text{Gain in percentage} = \frac{100\,(T - t)}{H - t}$$

Where H = total heat of steam at boiler pressure figured from 0° Fahrenheit.

T = temperature of feed water after heating.

t = temperature of feed water before heating.

It will be seen that the higher the temperature of the exhaust steam or flue gases, the greater is the gain.



GOEHRING BOILER AND SUPERHEATER; THE HEATING SURFACE OF THE LATTER IS FIFTY PER CENT OF THAT OF THE FORMER.

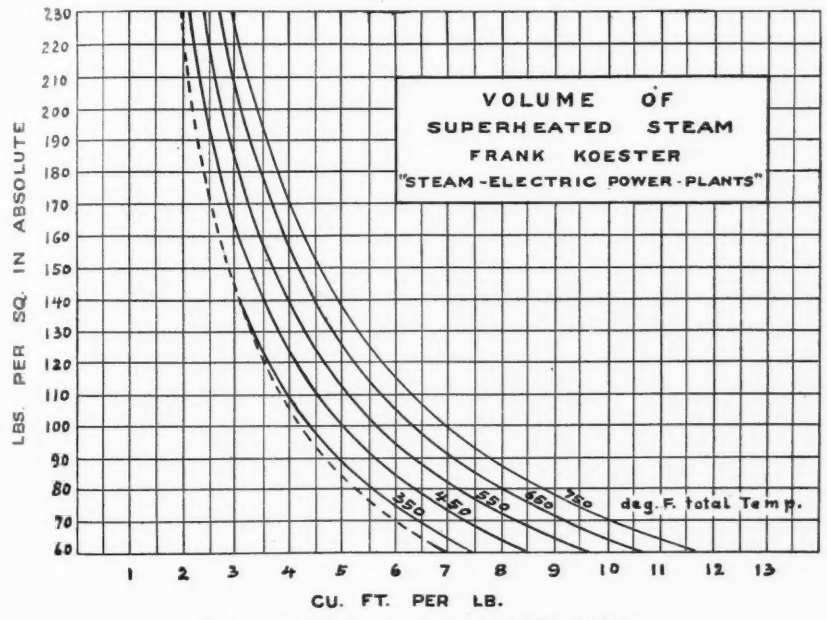
SUPERHEATERS.

Superheaters are constructed either of cast-iron or steel. The former is not as serviceable as the latter, unless some alloy of cast-iron is used, for the reason that the difference of temperature of the steam inside and the gas outside of the tubes causes the early destruction of the cast-iron. However, in the Foster construction, where the cast-iron rings are shrunk upon steel tubes, the liability of cracking is eliminated.

The steel-tube superheaters are classed as large and small tube heaters, and in the latter class is included the Babcock & Wilcox superheater. The Cruse superheater belongs to the large-tube class, to which also belongs the "Adorjan," the latter two belonging also to the controllable type. The temperature of the steam in the Cruse superheater is controlled by conducting the feed water through a tube

inserted in the steam tube, while the Adorjan uses atmospheric air instead of boiler feed water for controlling purposes. There are other devices for controlling the temperature of superheated steam, such as mixing saturated steam therewith or injecting a fine spray of water into the superheated steam. The latter, however, is objectionable for the reason that the conductivity of the superheated steam is so extremely low, and it is very possible that the injected water may be carried into the prime mover without being evaporated.

With reference to the flow of steam and gases the superheaters are divided into various classes, the general divisions being "parallel-current" and "counter-current" superheaters. The counter-current apparatus is of higher efficiency than the parallel-current, the theoretical ratio being 1:1.158. In order to secure a uniform temperature throughout the apparatus the combination of half parallel-current and half counter-current is best adapted.



CHARACTERISTICS OF SUPERHEATED STEAM.

No fixed formula can be given for calculating the size of a superheater, as it depends altogether upon the type and character of apparatus installed. However, formulas may be established for each individual type of superheater. Some data based upon practical experience with one of the small tube superheaters (with a steam pressure of 175 to 225 pounds), located in the setting of the water-tube boiler, shows a heating surface of from ten to twelve per cent of the heating surface of the boiler, to secure a total temperature of from 460 degrees to 500 degrees Fahrenheit, while a heating surface of twenty per cent of that of the boiler will give a temperature of approximately 570 degrees to 600 degrees Fahrenheit. If the proportion is 3 to 1, a temperature of about 660 degrees Fahrenheit may be secured. Superheaters with this proportion of heating surface are not used in America, while they are found in extensive use on the continent of Europe; in fact, there are a number in which the proportion of heating surface of boiler to that of superheater is 2 to 1. An illustration showing a boiler setting and superheater of this size is shown herewith. It will be noticed that the superheater is half parallel and half counter-current flow.

Separately fired superheaters in connection with central stations are little used, owing to the advantages arising in the installation of superheaters within the boiler setting, which is already provided with coal and ash handling apparatus and for which no additional operating force is required.

SUPERHEATED STEAM.

The gain due to the reduction of the steam consumption, when superheated steam is used, varies with the type of prime mover, viz., with the Curtis steam turbine, for each 12.5 degrees Fahrenheit of superheat one per cent reduction in the steam consumption may be secured, while first-class Continental reciprocating engines have shown a gain of one per cent for every nine degrees Fahrenheit of superheat. In both cases, however, there is a practical limit to this percentage of gain. In prime movers not designed for superheated steam the gain, in percentage, when superheataed steam is applied, will be greater than in a prime mover especially designed for the use of superheated steam, although the lowest total steam consumption per indicated horsepower will be secured by the latter prime mover.

The specific heat of superheated steam varies with the temperature. According to Regnault, it is 0.48 at atmospheric pressure. Later investigation shows that with a temperature of 100 degrees Fahrenheit the specific heat is 0.65, while at 200 degrees Fahrenheit it is 0.75.

The volume of superheated steam may be determined by Zeuner's formula, and the following chart has been plotted with this formula as a basis. It has been previously used by the author, but is given herewith in order to furnish more complete data on this subject.

It will readily be noted from this chart that the volume of superheated steam at 185 pounds pressure and 550 degrees total temperature (175 degrees superheat) is three cubic feet per pound, while the volume of saturated steam at this same pressure is 2.45 cubic feet per pound.

It would appear from the practice that a total temperature of from 480 degrees to 500 degrees Fahrenheit is considered a high temperature of superheat in this country, while in Europe temperatures of from 550 degrees to 650 degrees Fahrenheit are considered fairly high, and temperatures as high as 700 degrees to 750 degrees Fahrenheit are employed, the latter, however, being in exceptional cases only.

As it is impossible in connection with any proposition to secure an advantage without a disadvantage attached, the only question is, does the advantage outstrip the disadvantages? A comparison of the costs is the logical treatment of the subject, and the following remarks are suggestive of the method to be followed.

The advantage in the employment of superheated steam consists in the reduction of the steam or coal consumption, while the disadvantage embraces the higher cost of suitable engines, which are necessarily of a higher degree as to both workmanship and material.

Again, we have to consider the advantage of a lower cost of piping, since a greater velocity of steam may be employed. However, somewhat more expensive valves must be used and the additional cost of the superheater must also be taken into account.

[To be continued.]

WHY LABORATORY EFFICIENCY OF A LIGHT SOURCE DIFFERS FROM EFFICIENCY OF ILLUMINATION.

BY A. L. EUSTICE.

The great advance in the efficiency of modern illuminants and the application of same to the requirements of commercial practice have not only resulted in a more careful study and analysis of the existing lighting situation, and thereby advanced the art of illumination, but also have educated the lamp buyer, in a great measure, to the real difference which exists between light and illumination. The result of the vast amount of energy which has been spent in this direction is an ever-increasing demand, on the part of the purchaser of lighting equipment, for comparative figures of total operating costs (materials, labor and current) based on an equality of illumination when the system is operating under conditions of commercial maintenance.

When the time comes, therefore, to buy illumination, on the basis of illumination actually produced, as has already been done in a few important installations of lighting systems, the working efficiency, or average illuminating results, will be of far greater importance than the laboratory efficiency of the individual units employed in the system.

While the candlepower performance curves of individual units are recognized to be invaluable to the illuminating engineer in setting forth a tentative scheme for the layout of a new installation of lighting equipment, the information presented in such curves is confined to the efficiency of the light source, that is, the efficiency of transformation of electrical energy into light, and, further, when the same is operating under more ideal conditions than ever exist on commercial circuits.

That the working efficiency of a system does not necessarily depend entirely upon the efficiency of the individual unit employed can be proven with no lengthy argument when consideration is given to the many other determining factors which enter into the problem, for it must be borne in mind that to obtain efficiency of illumination, there is required not only a knowledge of lamp efficiency, but also efficiency of distribution, of application and of visual perception.

It is at once obvious that the laboratory performance curves, however representative of commercial service they may be, cannot supply the various elements of efficiency of installation which must be considered collectively to determine the final working efficiency of the system; and it is the purpose of the author to outline herewith the most important conditions which have considerable bearing on the satisfactory operation of a lighting system, and also the principal differences between laboratory and commercial practice.

The great variation in laboratory and practical results, obtained from the various types of illuminants now on the market, can be appreciated only by those who are in close touch with laboratory work, and it will be indeed surprising to many to note the wide range of results which it is possible, and very often are secured when the units are operated under practical conditions.

The cause of such variable results is at once apparent, for, according to existing laboratory practice, the laboratory performance curves, upon which all calculations are based, are always secured when the unit is operating under more favorable conditions than can be found in practice; that is, when the unit is new and clean, and maintained at either normal current, voltage or efficiency (depending on the specific type of unit) and with the auxiliary reflecting device, when such is used, adjusted more accurately, by far, than it is possible to maintain when the unit is placed in commercial service.

It is only natural that the manufacturers of illuminants and reflectors should give only those performance curves to the technical and lamp-buying public which show the performance of their units to the best advantage, with a result in many cases that calculations are made for a system on the basis of a unit whose characteristics show great variations in actual service.

A common point of difference between laboratory and commercial practice is the custom of maintaining high-efficiency incandescent lamps at rated efficiency for test purposes and entirely disregard the rated voltage, which condition is obviously not fulfilled in practice when the lamp is operated, not at rated efficiency, but at rated voltage, or even in some instances below rated voltage, in order to secure a longer life. Any errors in rating and early blackening of some lamps also effect this variation from theoretical results. Again, the lamps are often subjected to poor regulation on commercial circuits with a resultant candlepower depreciation different from the supposed value for a given period of service.

Perhaps of equal importance with the variations in performance of the lamp itself, is the variation in the efficiency of reflection and distribution of reflecting devices. In prismatic glassware, the use of which is popular in connection with high-efficiency incandescent lamps, the reflectors made from a new mold have relatively true prisms, and hence, possess high efficiency of reflection, but it is a well-recognized fact that the reflectors gradually lose some of their reflecting power as the molds become worn from service and cleaning, and the prisms become slightly curved surfaces, so that a lamp with both the first and last piece from a mold will give different results. Again, the shape of the prismatic glassware may be changed in the annealing process, with a resultant effect on the distribution and efficiency.

Unfortunately, from a practical standpoint, prismatic glassware of the old bowl types is so designed that the desired nature of distribution can be secured only when the lamp and reflector are within narrow limits of adjustment and with only small variations of relative position of lamp and reflector, the distribution can be varied from a very broad to a highly concentrated form. When the frequent misuse of shade holders and the differences between the bead and shell of commercial sockets is considered, the resultant nature of the distribution curve is more or less indefinite. Again, the relative position of filament and reflector is further effected by non-uniformity in length of support from the lamp base, and sagging of the filaments.

The use of enameled and acid-etched prismatic reflectors, now considered so essential in order to provide efficiency of visual perception, cuts down the efficiency of the unit very noticeably, yet the use of such glassware is to be encouraged where due regard is given the eye. But is it not a fallacy to use prismatic glassware so treated that its reflecting surface virtually becomes the inner surface, and to base calculations on the performance of the same by applying an absorption factor to the performance of the same type clear, as is frequently done in practice, without considering the change in form of distribution?

The advent of reflectors of the opal type for use on incandescent lamps introduces even further factors of uncertainty, due principally to differences in quality of glass, shape and weight; and in glassware of the round or ball type, where reflecting qualities have no bearing, such as is commonly used on the Nernst lamp,

non-uniformity in thickness and amount of coloring effect the absorption and consequently the efficiency and nature of the distribution curve.

Although the Nernst lamp does not depend upon a downward distribution by means of reflectors, there is also a range in candlepower performance, depending on the relative position of the glowers to the globe.

The loss of reflecting qualities of glassware, due to deterioration of the surface with age, should not be overlooked, and the effect of accumulation of dirt has, perhaps, the greatest effect on the satisfactory illumination delivered by the system.

It is logical, therefore, to conclude that an indication of the commercial performance of any unit should be derived by commercial, rather than laboratory, tests, in which all of the units are operating under commercial conditions, so that the common causes of difference outlined above are eliminated to a great extent and which further take into consideration the effect of surroundings. Such practical tests show, not what a lamp theoretically should do, but what the lamp actually does when operating under normal service conditions.

Within the past few months, figures have been given in the technical press which show the efficiency of various systems (lumens per watt), but at the present time, such figures should be considered as indicative rather than conclusive and should be used cautiously, for they are seriously incomplete with respect to the many combinations of units now in general use. As an illustration, a single value is given for tungsten lamps with clear prismatic reflectors, and it is apparent that the efficiency must change with various combinations. It is well recognized that a bowl frosted lamp when used with reflecting devices gives a different distribution and efficiency from a clear lamp of equal mean horizontal efficiency, and further, that as units are grouped in the form of clusters or in a single unit as a diffuser, the unit suffers a loss in efficiency, due to interference of light. In the diffuser and cluster, it is also to be noted that efficiency is reduced as the number of lamps in a unit are increased, while in the Nernst lamp the opposite characteristic is present, that is, the efficiency of the unit increases as the size of lamp, or number of glowers are increased.

The foregoing remarks indicate that it is important and essential, then, in arriving at figures on the illumination efficiency of lighting systems, to determine the relative efficiencies in the broad sense of the various systems of illumination, and not the relative efficiencies of the individual light sources.

Hudson Companies.

The two lower tubes of the Hudson Companies at Dey Street, New York city, entering the big terminal building, will be in operation about July 1. The tubes between Christopher Street and Hoboken have been in operation for some time.

The two upper tubes are now handling at the rate of 17,000,000 passengers yearly and it is estimated that when the entire four tubes are in operation they will start out with a traffic at the rate of 77,000,000 people per annum. There is a travel between Manhattan and Jersey City of 128,000,000 people per annum. The Hudson Companies bases its estimates of gross earnings on securing sixty per cent of this travel from the outset.

The tunnels admit of a very low operating ratio, including suitable provision for maintenance. It is figured that operation, maintenance and taxes will not require over forty per cent of gross, leaving a balance of rising $2,310,000 net from passengers. The terminal buildings are valued at over $15,000,000 and are yielding a net at the rate of $1,200,00 yearly. Miscellaneous receipts from other sources will bring total net up to about $3,800,000, or over $1,000,000 above all interest and sinking fund requirements.

The capacity of the present Hudson system is about 125,000,000 passengers per annum, so that on the basis of 77,000,000 passengers at the outset, the company has room for a sixty-six per cent expansion without additional construction or enlargement of the present capital outstanding.

Center Side-Door Subway Train.

General Manager Frank Hedley of the Interborough Rapid Transit Company, New York city, announces that an experimental eight-car Subway train with center doors had been tried in the small hours recently for the purpose of testing the clearances allowed by the doors on the curving platforms. No passengers were carried and the side doors were not opened during the trip.

After some minor changes and a second trial the train will be put in regular operation.

Keep Up Their Equipment.

The effort that has been made by electric traction companies, despite the recent business depression, to keep their systems in good operating condition, is not particularly recognized; but one evidence recently brought to the attention of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN is the fact that, since January 1 of this year, the Allis-Chalmers Company of Milwaukee, one of the largest builders of street and interurban-railway apparatus in the country, has received orders for nearly 1,000 air-brake equipments. These include the company's latest type of straight air-brake equipments for single-car operation, straight air emergency equipments, combined straight and automatic air-brake equipments for two or three-car trains and automatic air-brake equipments for electric locomotives and heavy interurban trains. For instance, among the companies buying such equipment are the following: Tampa & Sulphur Springs Traction Company, Tampa, Fla.; Third Avenue Railway Company, New York; Tarrytown & White Plains Railway Company, White Plains, N. Y.; Yonkers Street Railway Company, Yonkers, N. Y.; Omaha & Council Bluffs Street Railway, Omaha, Neb.; Conestoga Traction Company, Lancaster, Pa.; Ogden Rapid Transit Company, Ogden, Utah; Atlantic Shore Line Railway Company, Kennebunk, Me.; General Construction Company, Omaha, Neb.; Sandusky, Norwalk & Mansfield Railway Company, Norwalk, Ohio; Shelbourne Falls & Colrain Street Railway Company, Shelbourne Falls, Mass.; Chester Traction Company, Chester, Pa.; Lebanon Valley Street Railway Company, Lebanon, Pa.; Rochester Railway Company, Rochester, N. Y.; Eastern Wisconsin Railway and Light Company, Fond du Lac, Wis.; Transit Supply Company, Minneapolis, Minn.; and the Chicago City Railway Company, Chicago, Ill.

Brooklyn Subway.

The Appellate Division of the Supreme Court has affirmed the decision of Justice Erlanger in refusing to make permanent an injunction against the mayor and other officials of New York city, restraining them from letting contracts for the construction of the Fourth Avenue Subway, Brooklyn. Justice Erlanger's decision was based on the report made by General Tracy as to the city's debt limit, and the decision of Justice Erlanger approves Tracy's figures.

The New Building of the Lotos Club, New York City.

The Lotos Club of New York city is probably one of the most exclusive and homelike institutions representing modern club life in the great metropolis. Its membership is composed of jurists, lawyers, artists, architects, sculptors, literary and other professional men of prominence and marked attainment. For years the home of the club was on historic ground on Fifth Avenue, but the trend of commercial development made it expedient to part with this property, the financial value of which to the club made it possible to move further uptown in a quieter and more beautiful neighborhood, and build for itself a clubhouse which would meet with the exacting demands of its membership. The building was completed late last year, and the formal house-warming took place early in the present year. Both inside and out the aim of the architects has been to emulate the idea of modern luxuriousness, attaining this end with such simplicity and quiet effect that there is in no instance any indication of garishness or overdisplay. The illuminating fixtures were given particular study, and the effects produced are unique and pleasing in the extreme. The accompanying illustrations give a good idea of the appointments and indicate the careful selection of lighting fixtures and the harmonious ensemble of these with the other details of furnishing.

The building has a frontage of seventy-five feet on the south side of Fifty-seventh Street. The facade is treated in the style of the Italian Renaissance, the ground story being of limestone, with arched openings, and surmounted by a stone balcony. The balance of the facade is in rough gray oriental brick, with wide joints, interspersed with square headers bearing Lotos flowers of white color, arranged to form diaper patterns throughout the wall surface. The frieze underneath the sixth-floor balcony is of brick pattern of the same material. Above the sixth-floor balcony, which is of wrought-iron, the picture gallery is represented by a treatment of arched panels, carried out in colored terra-cotta and gray brick, with varicolored headers forming diaper patterns. This story is surmounted by the main cornice, which is of wide projecting bracketed beams, executed in metal, and treated with rich colors on the soffits.

The main entrance is in the center, raised a few steps above the sidewalk level, with vestibule of ornamental cast-iron, and groups of lanterns bracketed from the wall on either side. At the east end of the facade, entering directly from the level of the sidewalk, is the ladies' entrance door, leading to the ladies' private stairway, which gives direct access to the ladies' dining room on the second story.

The basement and first and second floors and the entire sixth floor are devoted to the social purposes of the club; the third and fourth floors and half of the fifth floor are devoted to bedrooms; the remaining half of the fifth floor is devoted to the kitchen and its appurtenances. The seventh floor, which covers approximately half of the area of the building at the rear, is devoted to the servants' bedrooms and servants' halls.

The major part of the basement and ground floor is occupied by the den and billiard room. The den is thirty-four feet wide and forty-three feet long, with the members' bar opening from one side of it and a fireplace and alcove at the end. The billiard room is twenty-two feet wide and fifty-three feet long, with toilet room adjoining.

The heating plant and mechanical plant are in the vaults under the sidewalk.

All goods and supplies are received by means of a sidewalk lift and area stairs at the west end of the building, which opens directly to the service entrance hallway, which extends along the west side of the basement to the freight elevator and dumbwaiters. These in turn distribute directly to the pantries and storeroom on the upper floors. At the rear of the basement are the wineroom and general storage space.

We enter into a large entrance hall, which opens at the left into the coatroom and through the same to the private stair leading to the strangers' room, placed in the mezzanine over the coatroom; pass directly from the entrance hall into the foyer, which opens to the left, into the club offices, main staircase and elevators, and on the right to the front parlor, a room twenty-two feet wide and twenty-nine feet long, and to the middle parlor, a room twenty-four feet wide and thirty-nine feet long. At the further end of the foyer is the café, a room twenty-seven feet wide and forty-four feet long, extending across the rear of the building, with adjoining serving pantry.

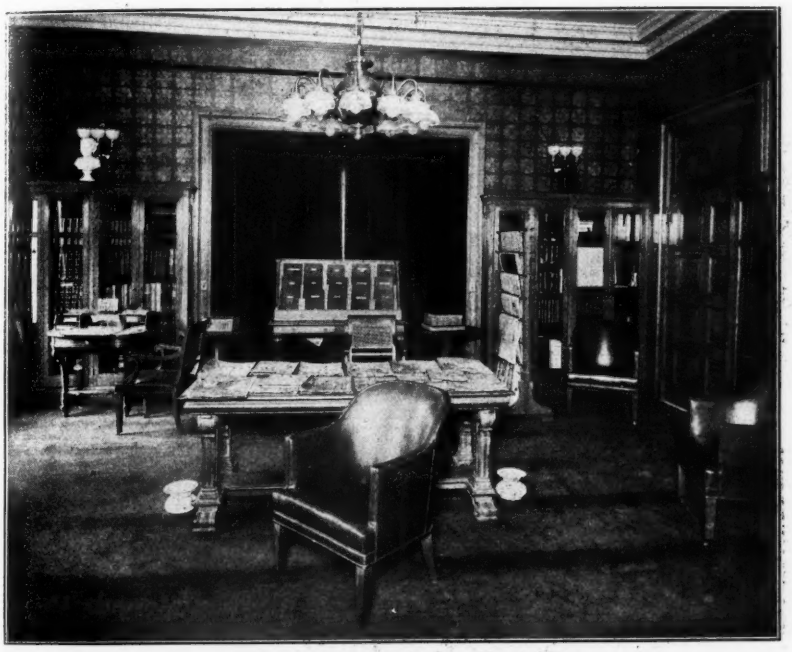
FOYER AND STAIRCASE HALL, LOOKING TOWARD ENTRANCE, LOTOS CLUB, NEW YORK.

The main stairs lead to the second-story hall and down directly to the den; passing under the main stairs, back of the elevators, the general lavatory is reached.

On the second floor the main stairs, at the center of the east side of the building, are lighted from above and lead into the general hall, into which the elevators also open and from which two corridors pass to the rooms at the front and rear of the building. Across the front of this room is the cardroom, arranged for five tables; the library, a room twenty feet wide and twenty-two feet long, and the lounging room, twenty-two feet wide and twenty-nine feet long. At the middle of the building, on the west side, opening directly from the stair hall, is a private dining room, which will be used also as

a meeting room for the board of directors. Across the back or south side of this floor are two private dining rooms, intended for the use of ladies. Taken together, these rooms are twenty-one feet wide and fifty feet long. The various rooms on the second floor open together by means of sliding doors, so that they may be readily used in groups for large private dinners, etc.

Each of the third and fourth floors has thirteen bedrooms, four private bathrooms, two bathrooms which may be either private or general, and one general bath. The rooms are so arranged that many suites of two or more rooms may be had. The bedroom portion of the fifth floor contains six bedrooms, two private baths and one general bath. In connection with this portion of the fifth floor there is also a valet's pressing room and barber's shop.



THE LIBRARY, LOTOS CLUB, NEW YORK.

The kitchen proper extends across the south of the building and is a room twenty-one feet wide and forty feet long, with an office for the chef, and the dumbwaiters, service stairs and service elevator communicating directly with it at its west end, and with scullery and vegetable storage and workroom opening from it at the east end. Opening directly from the kitchen proper and extending back to the middle of the building are the butcher shop, oyster bar and general pantry and kitchen storeroom. These offices occupy a space fourteen feet wide and forty-three feet long. In connection with the butcher shop there are large refrigerators, subdivided for the keeping of cooked meats, fresh meat, poultry, game and fish. In connection with the oyster bar is a large refrigerator for shellfish, and opening into the general pantry are large refrigerators for the storage of milk, butter, eggs, fruit and like products.

On the sixth floor the main stairs and elevator open into the hallway at the east side of the building, which leads to an ante-room, with general toilet adjacent, occupying the southeast corner of this floor. From the ante-room and from the hall we pass directly into the main dining room, which is twenty-nine feet wide and fifty-four feet long, abundantly lighted at the end, which looks to the south, and from the light courts at each side near the north end of the room. A large service room joins the dining room at the west, with separate special staircase for the waiters, leading directly down to the kitchen on the floor below.

The north end of the dining room is separated from the picture gallery by a partition, which is removable for the full height and width of the room. The picture gallery is a room thirty feet wide by seventy feet long, lighted entirely by skylight, and, together with the dining, the separating partitions having been removed, forms a spacious T-shaped banquet hall, capable of seating more than 400 guests.

The building is lighted throughout with electricity. Telephone booths and other telephone stations communicating with the public service through central switchboard and providing intercommunication in the club itself, are found near the den, in the coatroom, office, café, main hall on the second floor, ladies' dining rooms, all bedrooms, the ante-room to the main dining room and throughout the various portions of the service. The service parts of the club are equipped with automatically regulated clocks, giving the uniform public standard time. Clocks on this system are also located near the den, in the second-story hall and the office.

The building is heated throughout from low-pressure steam boilers by direct radiation, except in the public rooms of the first, second and sixth floors. The rooms on these floors have either indirect radiation or enclosed radiators, and in some cases both. All parts of the building are supplied with fresh air warmed to the normal temperature of the interior of the building and forced to its destination by motor-driven fans. All parts of the building are likewise ventilated by means of motor-driven fans placed in the roof-house, above the seventh floor. All indirect radiation is automatically controlled both as to steam circulation and fresh-air supply.

The refrigerators, of which there is one in each serving room in the basement, first story, second story and sixth story, besides those mentioned in connection with the kitchen, are cooled by means of brine which has been chilled by a compressed ammonia plant, circulated through coils placed in the refrigerator boxes. The refrigerators for the bar and the wine cellars are cooled in like manner. The refrigerating plant also makes a daily supply of ice for drinking purposes.

The kitchen is equipped with a steel range having four fires and ovens, charcoal broiler and gas broiler, soup and vegetable kettles and steam table, heated by high-pressure steam from a special boiler located in the boiler room of the basement. There are three dumbwaiters arranged in a group, passing through the kitchen to all the various serving rooms and run by electric motors, which are automatically operated from the kitchen and have a special intercommunicating telephone system in connection with them. There is one large electrically driven elevator for the general freight and service use communicating to each floor, and two large electric passenger elevators for the general club use.

The building throughout is as nearly

fireproof as any modern building of this type can be made. The foundations rest on rock and the exterior walls are of self-supporting masonry. The floors are carried on steel columns, girders and beams, with terra-cotta arches. All portions of the steel are completely and carefully covered with terra-cotta or brick masonry, laid in cement mortar. All ceilings are formed of galvanized metal lathing. The stairways are built of steel or cast-iron, with marble or slate treads. There are marble treads for the public stairs and slate treads for the service stairs, and the treads and platforms of both are reinforced with steel plates.

The floors throughout the building are finished either with cement, tile or marble, as the location may require. There is no wood used for floors in the building. All carpets are laid directly on these finished masonry floors.

The floors of the den and billiard room are laid with red vitrified tile and slate base. The walls and ceilings are finished in plaster, painted in harmonious colors. The floors in the entrance hall, foyer and café are laid in marble and terazzo, and the walls and ceilings are finished in decorated plaster, painted in harmonious tones. The floors in the two parlors are, of course, carpeted, and the walls above a paneled oak dado, about three feet high, are covered with woven material. The ceilings are of richly decorated plaster, painted in harmony with the walls. The second-story main hall is finished in similar manner to the foyer, and the card-room, library, lounging room, private dining rooms in similar manner to the parlors, except that the walls are covered with stretched Japanese grass-cloth. The various halls above the second floor throughout the building are finished in cement, with mosaic borders and marble base, the hall carpets being laid over the cement. The walls and ceilings of the halls are painted in light colors.

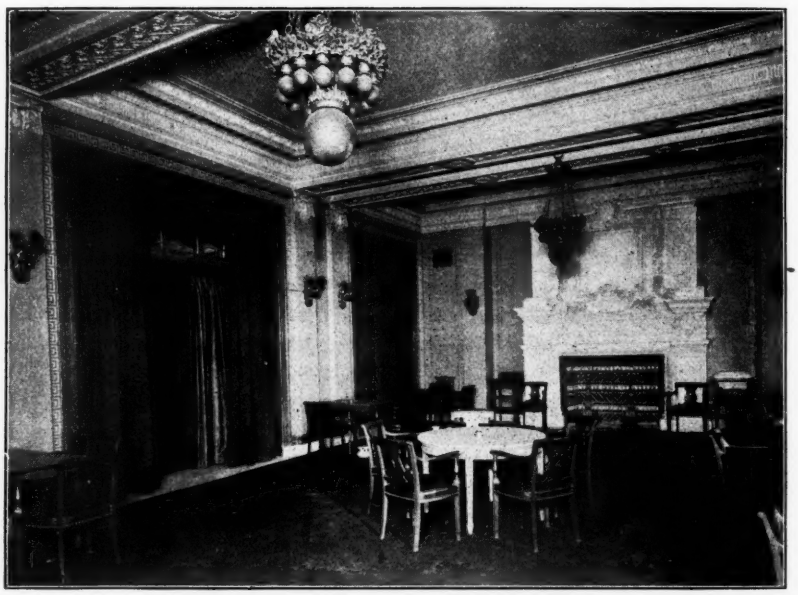
The bedrooms throughout have cement floors, covered by heavy carpets, papered walls and painted ceilings. The bath-rooms and toilet rooms throughout have tile floors and walls and high-grade, modern plumbing fixtures. The floors of the main dining room and picture gallery are of cement, covered with heavy carpets, and the walls in the main dining room are hung with paper, which has been specially prepared, and the ceiling is treated with ornamental plaster, printed in harmony with the walls. The walls of the picture gallery are hung with woven material as a background to the collection of paintings which this room is to contain. That portion of the ceiling which is not taken up with the skylight is formed of ornamental plaster, painted in harmony with the walls.

The building is, of course, commodiously furnished with rich and comfortable furniture of simple design. This furniture has been especially made for this club, with the exception of some few items, such as small dining tables and the like, taken over from the equipment of the old club.

The various exterior openings of the social rooms and the interior openings where needed for the proper effect of warmth and richness have been hung with specially manufactured draperies in harmony with the color schemes of the room.

While some work was done last fall in the way of demolishing the previous building on the site and of excavation, the work actually began after the first of April, 1908, and the first foundation was laid on the first day of June, 1908. From this it will be seen that the building, which covers all of the available space on a site seventy-five feet wide by 100 feet deep, together with vaults and areas un-

THE CARD ROOM, LOTOS CLUB, NEW YORK.



THE CAFE, LOTOS CLUB, NEW YORK.

der the sidewalk, which covers an area of thirty feet wide by seventy-five feet long, has been executed, completed and turned over to the occupancy of the club within eight months. This has been accomplished without any additional expenditure for forced work either during or after the established working hours of labor. The entire business of decorating and furnishing the club has been carried on and performed and finished within the same limits of time. It is also worthy of comment that after having undertaken to produce the building at an extremely low cost, the entire operation has been completed at an expense to the club of between twenty and twenty-five per cent less than the present market value of the entire building construction.

The Lotos Club building committee, under whose direction the entire work of planning and fitting up the new building was carried out, consisted of John Elderkin, Chas. W. Price and William T. Evans. The architect was Donn Barber of New York, the builders were Mark Idletz & Son of New York, and the furnishings were installed by Phillips & Jullien. The lighting fixtures were supplied by the Lord Electric Company, and Okonite wire and cables have been used exclusively throughout the building. The reflectors in the art gallery were supplied by I. P. Frink and the New York Edison Company supplies all the electric current for lighting and power service.

The officers of the Lotos Club are Frank R. Lawrence, president; Chester S. Lord, vice-president; Dr. Alexander C. Humphreys, secretary, and Chas. W. Price, treasurer.

Competition in St. Louis.

A new organization, the Light and Power Company, has applied to the Board of Public Improvements at St. Louis for a permit to string its wires. The company owns an old franchise, granted some years ago, and if the present request is granted it means that this franchise is valid and that the lighting business of St. Louis is open to the new company.

Wonderful Increase in Students.

The figures recently supplied by the United States Bureau of Education show that the students in colleges, universities and schools of technology, who numbered 38,000 in 1880, 56,000 in 1890, and 98,000 in 1900, aggregated 130,000 in 1907.

Editor of "Power" Acquitted on Libel Charge.

Considerable attention was attracted by the thoroughgoing denouncing of John E. Carroll, of Philadelphia, Pa., in an article in the September, 1907, issue of *Power*. During the summer of 1907 Carroll undertook, in the exploitation of an engine, to run on carbon dioxide gas, and, according to *Power*, made some startling announcements with regard to the efficiency and operation of this motor. Mr. Carroll took exception to the publication of this information and also to testimony which F. R. Low, author of the article and senior editor of *Power*, gave in Philadelphia in behalf of the officers and stockholders of the company which had advanced some of the money for the development of this apparatus. Mr. Low was consequently indicted for alleged criminal libel. The libel suit was tried before the Philadelphia grand jury, and on May 13 the editor was acquitted, the judge instructing the jury to find for the defendant.

A Well-Known Telephone Man Honored.

The Emperor of Japan, upon the joint recommendation of the Ministers of Foreign Affairs and of Communication, has conferred upon U. N. Bethell, of New York, president of the New York & New Jersey Telephone Company, the Bell Telephone Company of Pennsylvania, and the Central New York Telephone and Telegraph Company, the Imperial Order of the Rising Sun.

This has been done in recognition of services rendered by Mr. Bethell in giving assistance to the representatives of the Japanese Government, who have been sent to this country within the last few years for the purpose of investigating the telephone system and the management of large industrial enterprises.

At the Japanese consulate it is said that this is the greatest distinction that can be conferred on a foreigner by the Japanese Government.

Ontario Opposes Power Bill.

Dispatches from Toronto, Can., state that, notwithstanding the passage of the Ontario & Michigan Power Company's bill in an amended form at Ottawa, Sir James Whitney will not relinquish the fight for provincial rights claimed. The Ontario Government is not content that its protests have been unheeded, and an immediate consideration will be given to such further steps as may be necessary to put the protest into practical effect.

Pennsylvania Tunnels to be Completed Next January.

The work of connecting the completed sections of the new Pennsylvania Railroad tunnel system with electric power was started in Long Island City on April 22, when workmen began laying the ducts between the power house in Fourth and Front streets and the tunnels. A trench six feet wide and four feet deep will be needed to carry the forty-eight ducts through which the power will be transmitted. The work will take about two-and-a-half months.

Terminal outlets for two of the tubes have already been completed in the new railroad yard, and it is proposed to have the tunnels between Long Island City and the station in Manhattan completed and equipped for operation by next January.

Fifty of the new steel cars are now being tried out in readiness for operation through the tunnels.

Electric lines not controlled by the Long Island Railroad are not to have access to the new tunnel system, and will still be compelled to depend upon the old Thirty-fourth Street Ferry, the new Queensboro Bridge and the Belmont tunnel when in operation.

Boston Subways.

Governor Draper of Massachusetts has signed the resolve referring to the railroad commission the twelve subway and tunnel bills which were referred to the committee on metropolitan affairs for its investigation and report to the next legislature with recommendations and suggestions.

New Haven Merger Plea Overruled.

Judges Colt, Putnam and Lowell of the United States Circuit Court have overruled the plea to jurisdiction of the court filed by the Rhode Island Company in the merger suit of the United States against the New York, New Haven & Hartford Railroad Company and others. The company filed an exception to the ruling and also filed a demurrer to the petition. The demurrer is based on technical objections to the pleading.

Toledo Railways and Light Company.

In order to facilitate refinancing of the Toledo Railways and Light Company, which has some $16,000,000 bonds maturing on July 1 next, a stockholders' committee has been formed to co-operate with the creditors. William E. Hutton, of Cleveland, Ohio, is chairman of the committee.

Chicago Section, Illuminating Engineering Society.

At the meeting of the Chicago Section of the Illuminating Engineering Society that was held in the Grand Pacific Hotel on May 13, W. E. Barrows, Jr., assistant professor of electrical engineering at Armour Institute of Technology, read a paper on some features of the illuminating engineering courses at that institution. An abstract of the paper follows:

In this country the consumers pay $250,000,000 a year for light and illumination, and as a conservative estimate one-tenth of this is annually wasted, due to carelessness or to ignorance of the principles of illuminating economy. From this phase of the situation it seems only consistent that the attention of the technical school should also be directed to this branch of engineering. Moreover, the larger number of illuminants available at the present time, each having its peculiarities and characteristics, and the new and improved methods of utilizing the light thereof, make it imperative that the engineer of the broader type should be conversant with the intricacies of this branch of engineering.

In view of these considerations and because of the general impetus given to this department of engineering during the past few years it was decided in September, 1907, to establish at Armour Institute of Technology in connection with the course in electrical engineering a short course devoted to the fundamentals of illuminating engineering to be given as a regular study to the senior electrical students. The method of instruction consisted of a set of notes compiled from the literature on the subject in the various technical magazines, supplemented by lectures illustrated by lantern slides. The ground covered consisted of the study of photometers and photometry, the various illuminants and their peculiarities, and problems and calculations pertaining to the distribution of light and the location of the luminous sources.

During the first semester of the present college year several experiments in photometry were added to the regular laboratory courses. The classroom work was developed and extended, the notes revised and put in more convenient form by the help of a publisher, and the interest shown by the students and the results obtained were very gratifying.

The course of instruction begins with the assumption that the student is familiar with the fundamental theory and laws of light as taught in the department of physics, and passes to the consideration of reflection from surfaces, absorption of glassware, intrinsic brilliancy and colors of light of luminous sources, working illumination intensities and color effects of different lamps. These are studied from a physiological and æsthetic point of view with the practical meaning and application constantly in sight. Considerable time is given to photometry, the principles and manipulation of photometers and the methods of representing and expressing the results obtained. The Purkinje effect receives due attention. The theory and use of the integrating photometers for determining the mean spherical or mean hemispherical candlepower are here considered, as are also the principles and modifications of the Rousseau and the Kennelly diagrams. The subject of photometric standards is followed by a study of the various light sources. These are discussed relative to their construction, operation, efficiency, life, cost, maintenance, color and distribution of light, and their adaptability and practicability for various classes of service.

Illumination calculations follow in order. The point-to-point method of calculating illumination intensity and the use of illuminating tables are followed by the flux-of-light method of Cravath and Lansingh, the absorption-of-light method of McAllister, the methods of securing uniform illumination of Wohlauer, the determination of the number and location of lamps, and the subject of light surveys. The course is concluded by a discourse on the fundamental principles of interior and exterior illumination.

It is evident that this subject covers considerable ground for a short course. With a little thought it will be evident that the average student in the time allotted this study can master only the fundamentals of its different phases and that they accomplish this is the aim of the instructor. Other facts, methods and systems are woven concentrically around the fundamentals to establish the fundamentals more securely and point out possibilities of more practical applications. An example of this follows:

The underlying principle of the Rousseau and the Kennelly diagrams, and of the integrating photometer as well, is that the luminous flux in any zone of an imaginary sphere surrounding a source of light is equal to

$$2\pi I (\cos a_1 - \cos a_2)$$

where $a_1 - a_2$ is the angle subtending the zone of reference, a_1 and a_2 being angles measured from the vertical, and I is the average intensity of illumination in that zone. The calculation of a few constants to correspond to a certain number of directions in a vertical plane at which the candlepower is measured will greatly facilitate the determination of the values of the mean spherical or mean hemispherical candlepower where the integrating photometer is not available, and also make simple the determination of the zonal flux in lumens in any region around the source. This can be best illustrated by an example. The values, measured from the vertical, are as follows:

Cos 0° — Cos 7° 30′ = .00856, corresponding to 0° from vertical.
Cos 7° 30′ — Cos 22° 30′ = .06756, corresponding to 15° from vertical.
Cos 22° 30′ — Cos 37° 30′ = .13053, corresponding to 30° from vertical.
Cos 37° 30′ — Cos 52° 30′ = .18459, corresponding to 45° from vertical.

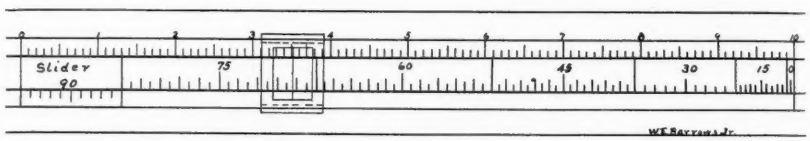


FIG. 1.—SLIDE-RULE FOR CALCULATING ILLUMINATION.

Cos 52° 30′ — Cos 67° 30′ = .22608, corresponding to 60° from vertical.
Cos 67° 30′ — Cos 82° 30′ = .25215, corresponding to 75° from vertical.
Cos 82° 30′ — Cos 90° = .13053, corresponding to 90° from vertical.

By multiplying the candlepower in the direction of 0, 15, 30, 45, 60, 75 and 90 degrees from the vertical by these constants and adding the products we get the approximate value of the mean hemispherical candlepower. Each of these products multiplied by 2π gives the flux in lumens in that zone and the summation of these values for the desired number of zones gives the total light flux therein in lumens.

The simplicity of the manipulation of these constants is shown in the following table, which gives the values of the candlepower at every fifteen degrees at and below the horizontal of a sixteen-candlepower lamp, the flux in lumens of the zones, and the mean hemispherical candlepower of the lamp:

Degrees from Vertical.	Candlepower in this Direction.	Zonal Constants.	Component of Mean Hemispherical C. P.	Light Flux in Lumens.
0	8.0	.00856	.0685	.43
15	8.8	.0675	.594	3.73
30	10.6	.1305	1.383	8.69
45	13.1	.1846	2.418	15.20
60	14.7	.2261	3.324	20.85
75	16.2	.2521	4.080	25.65
90	16.7	.1305	2.180	13.70
			14.0475	88.25

This shows a mean hemispherical value

of approximately fourteen candlepower, or 88.25 lumens.

It should be noted that these values of the flux of light are for zones extending 7° 30′ above 0°, below 90°, and either way for the 15, 30, 45, 60 and 70-degree directions.

A further saving in time may be secured by applying these constants to a slide rule, the construction of which is shown in Fig. I. The lower scale and the slide are divided into sections proportional to the constants given above, the sum of which is unity, and each section is divided into ten equal parts. The upper scale is of unit length, also subdivided. To determine the mean hemispherical candlepower by such a rule is the question of two or three minutes. The zero of the 75-degree scale on the slide is placed at the value of the 90-degree candlepower, reduced to scale, in the 90-degree section. The cross-hair on the rider is placed over the value of the 75-degree candlepower in the 75-degree section, and the zero of the 60-degree section is placed under the cross-hair, the rider remaining fixed. The cross-hair is then moved, the slide remaining in the same position, to the value of the 60-degree candlepower in the 60-degree section, and the zero of the 45-degree section placed under the cross-hair. This process is repeated for the 30, 15 and 0-degree sections, and the value of the mean hemispherical candlepower can be read off the upper scale under the final position of the cross-hair. The mean spherical candlepower may be easily determined from the values of the mean candlepower of the two hemispheres.

The chief advantages of this set of constants are that no curve plotting or construction of diagrams are necessary and that they apply to angles at which the candlepower is usually measured. The constants for the candlepower readings for every ten degrees throughout the hemisphere are given below and are used similar to those already discussed.

Degrees from Vertical at Which Candlepower is Considered.	Multiplying Constant.
0	.00381
10	.03026
20	.05962
30	.08716
40	.11204
50	.13353
60	.15096
70	.16380
80	.17166
90	.08716

If it is desired to determine the value of the mean spherical candlepower directly, constants equal to one-half the difference between the cosines of the angles determined by the various zones may be used, the sum of the products giving the desired result. The constant in this case for determining the flux is 4π, since the zonal constants have been halved. Below are given the values of these constants for every ten degrees and for every fifteen degrees throughout the spherical area.

Constants for Every 15 Degrees. Degrees at Which Candlepower is Considered.	Multiplying Constants.
0	.00428
15	.03378
30	.06526
45	.092295
60	.11304
75	.126075
90	.13053
105	.126075
120	.11304
135	.092295
150	.06526
165	.03378
180	.00428
Constants for Every 10 Degrees.	
0	.001905
10	.01513
20	.02981
30	.04358

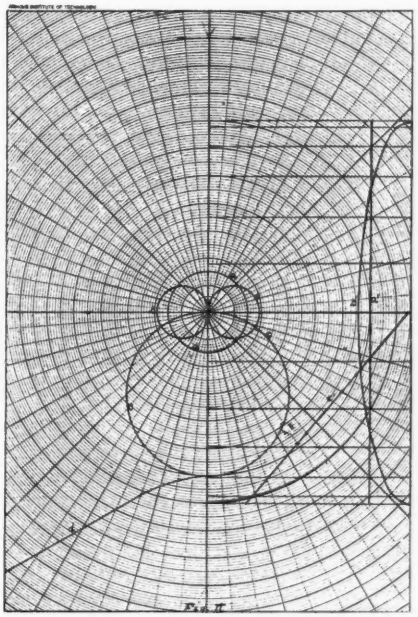


FIG. 2.—POLAR ILLUMINATION DIAGRAMS.

40	.05602
50	.066765
60	.07548
70	.08190
80	.08583
90	.08716
100	.08583
110	.08190
120	.07548
130	.066765
140	.05602
150	.04358
160	.02981
170	.01513
180	.001905

The young engineer is not satisfied with knowing the use of such constants. He goes back to the foundation of the case. He wants to know if the results he gets are correct, and if so, how they are obtained. And although he may perhaps never have occasion to use the principles of the Rousseau diagram in the sense here illustrated, he has had impressed upon him certain practical applications of spherical trigonometry in a way which may make easier the solution of other problems. It is instances like those just cited which produce a capacity on the part of the student for becoming an engineer, and to produce this capacity is the function pure and simple of the technical school.

Another point as a further illustration of the work and bearing on the same phase of the subject is the suggestion of the wrong conception possible from the study of the polar representation of the distribution of light from a luminous source. In Fig. II are shown by the curves *a*, *b* and *c* three theoretical distributions of light, the mean spherical values of which are the same. The maximum values in the three cases are in the ratio of 15-19-60. The values of the total luminous flux from each are indicated by the curves *a′*, *b′* and *c′* on the Rousseau diagram at the right of the figure, which represent the true spherical values of the candlepower.

The illuminating values of the sources are more clearly shown by the polar diagrams. The theoretical polar distribution of light for uniform illumination beneath the lamp is shown by curve *d* on the lower left-hand side of the sheet. It is suggested that this curve be included for reference on the sheets showing the distribution of light from lamps intended for distributed lighting.

A course in illuminating engineering laboratory of three hours a week is catalogued for the next semester to parallel the classroom instruction. The general nature of the experiments has already been outlined. The laboratory equipment available for students in photometry and illumination measurements comprises a standard photometer bench and dark room; Bunsen, Lummer-Brodhum and flicker types of photometers for use with the bench; Weber photometer; Sharp-Millar photometer; Ulbricht globe photometer; Pentane lamp; Hefner standard lamps; incandescent lamps certified by the Bureau of Standards; rotating devices for incandescent lamps, and potentiometers for standardizing the measuring instruments. This course in illuminating engineering has been a reality from the start. It has been recognized as a necessity in the proper equipment of the electrical engineer. While the future is only prophetic, one may rest assured that its progress and growth will reflect the developments which have been made and are going on in the commercial side of illuminating engineering.

THE STORY OF A SUCCESSFUL SIGN CAMPAIGN.[1]

BY J. B. LINDL.

This is an account of a successful electric-sign campaign recently conducted by the Union Electric Company at Dubuque, Iowa.

The first step taken to popularize electric-sign advertising was to enter into negotiations with the two daily papers for an advertising-exchange proposition, by offering to erect an electric sign on the office of each of the two daily papers, and to furnish current for operating the same at the regular sign rate, in exchange for advertising space at the regular rates in the papers.

The cost of the sign was added to the cost of current for operating same on a flat rate from dusk until 10 p. m. each night for one year, and the total divided into twelve equal installments, a bill for each of which was rendered to, and paid for, by the papers each month. The papers in turn rendered a bill for the advertising each month, which is paid for by the company, thus putting the matter on a cash basis, and avoiding confusion in accounting.

After these two signs had been erected we were ready to commence the campaign in earnest.

The signs were erected at night, between Saturday and Sunday, and in the Sunday issues of the papers appeared the following advertisement: "LOOK AT THE NEW ELECTRIC SIGN WHICH WE HAVE ERECTED FOR THE TIMES - JOURNAL." Below this, "Newspaper men know good advertising when they see it. If Electric-sign advertising is good for them, it is good for you. LET US MAKE YOU AN ESTIMATE."

The same advertisement appeared in the other paper, *The Telegraph-Herald*, with the only difference that the name of that paper was given.

The advantage of having large electric signs on newspaper offices is at once apparent when one considers the powerful talking-point it offers, and the fact that a paper which has $200 to $300 invested in a sign is not likely to actively support any movement toward adverse and restrictive legislation by the City Council or sign ordinances.

In addition to the newspaper advertising referred to above, the following circular letter was mailed to 500 business houses so as to reach them in the Sunday mail:

Gentlemen: You will certainly agree with us when we say that advertising is the life of trade. The very fact that such firms as Marshall Field & Company, Swift Packing Company, and other equally successful merchants say that their advertising departments are the most important branches of the business, should convince you of the truth of the above saying. So many great commercial enterprises have been built up by advertising, and so many non-advertisers have failed that but one conclusion can be reached, and that is, "If you wish to succeed you must advertise."

We agree with you when you say that every business cannot go into publicity on as extensive a scale as the above-mentioned firms, but every business can INVEST the same percentage of its gross revenue in BUSINESS - BRINGING PUBLICITY, and MUST do so if it wishes to keep on growing.

Now let us consider the best medium for bringing a business before the public. The newspaper is the oldest and best-known means of bringing a business before the public, but within the last three years a new and more effective medium has been brought into prominence, namely, the ELECTRIC SIGN, which has many advantages over other forms of advertising, chief of which is the low cost per prospective buyer reached. For instance, a sign costing, say, $12 per month will be seen and read by thousands of people, where with $12 worth of any other kind of advertising you will hardly reach hundreds. Then, too, the Electric Sign brings your business before the people at a time when they are on the street, and are at leisure to consider your line and when they are there for the purpose of doing business. That is an ideal combination, is it not?

The fact that we have closed a contract for a sign with the two daily papers should convince you of the value of Electric advertising, and good advertising is good for any business.

We have recently commenced building our own signs and find that we can build them for about one-third less than sign companies, which, in connection with the fact that the holiday season, during which you get the best results from your advertising, is near at hand, makes this the time to start burning your name and business into the minds of the prospective buyer. Don't fail to mail the enclosed post-card for further particulars.

Not knowing anything about the signs, as they had been erected at night, some of the merchants considered the letter a joke or an advertising dodge, but when they came up town the next evening and saw the two monster signs up against the skyline, it seems they became convinced of the truth of all of the letter when they found that the reference to the signs was true.

DUBUQUE STREET BEFORE ELECTRIC-SIGN CAMPAIGN.

DUBUQUE STREET AFTER ELECTRIC-SIGN CAMPAIGN.

Be this as it may, the fact is that on Monday morning there were five postal inquiries on my desk, altogether contrary to the fact that I had been told that there would be no results from the letter. Four more inquiries came in during the rest of the day, and out of the nine inquiries received, four orders for signs were closed.

The method employed in selling these, as well as the test of the signs, was to sell advertising, not signs, as nearly every merchant believes in advertising.

For instance, when we received an inquiry from a prospect, we would draw up a design, make an estimate on the cost of construction and erection, add to this the cost per year of the current to operate same on a flat rate, divide the total by twelve, and make the merchant the following proposition:

Say, for instance, that the cost of the sign was $96, and it took eighty two-can-

[1] Abstract of a paper read before the Iowa Electrical Association, at Cedar Rapids, Iowa, April 22, 1909.

dlepower lamps to illuminate same, we would make up the following figures: A two-candlepower lamp burning from dusk until 10 p. m., or 120 hours per month at six cents per kilowatt-hour, figures $1.20 per year, or $96 per year for the eighty lamps; adding to this the cost of the sign as above, we have $192 divided by twelve, which gives $16 per month for the first year.

We would then call on the merchant and draw his attention to the advertising value of an electric sign by showing him that with the sign he would reach everybody within three blocks of his store, while the people were on the street and at leisure to consider his line.

We would further show him that with $16 worth of this kind of advertising he would reach almost the entire population of the city, at least once a week, where, with $16 worth of newspaper advertising at fifteen cents per inch, which is the rate in Dubuque, he would only have four inches of space. As it does not take a very keen insight into the advertising game to see how much chance a four-inch advertisement has of being seen and read, as compared with the electric sign, it is not a hard matter to close a deal for a sign, provided the merchant is at all progressive.

Dividing the first cost of the sign up into twelve payments helped us a great deal in getting the campaign started, as most of the merchants make a monthly charge to advertising, and if the total first cost of the sign was to be charged to advertising in one month, it would leave the account for that month out of all proportion to the rest of the year.

After these signs had been erected we sent out another circular letter drawing attention to the four most progressive and up-to-date merchants and the valuable advertising they were getting out of their electric signs. As no merchant wants to be called a back-number, this brought in another lot of inquiries, and from that time on we were able to close all the way from one to three signs per week.

This got us along toward winter, and about that time a movement was started in the papers to "Boost Dubuque."

We took advantage of this by embodying in our advertising the fact that nothing could be more of a boost to the city than to have the main street of the city so well illuminated with electric signs that it, like Broadway, could be called "The Great White Way." This appealed to the civic pride of a number of the merchants, and got them to a point where they were willing to put their signature on the dotted line.

One of the best pulling ads of the entire campaign was run at this time, and it ran as follows: "LIFE AND LIGHT start with the same letter. Commercially they are synonymous. There is always life in a well-lighted city. BE A LIVE ONE and boost Dubuque by advertising with an ELECTRIC SIGN." Diagonally opposite, on the same page of the paper, appeared the following: "DEAD AND DARK start with the same letter. In a commercial way they stand for the same thing. You never saw a lot of people walking up and down the dark streets of a dead town looking at goods in a dark show-window. DON'T BE A DEAD ONE, BUT BOOST DUBUQUE by advertising with an ELECTRIC SIGN."

By this time twenty signs had been erected, and one could see a constant increase in the crowds on our main street in the evening.

This was again fired at non-users of electric signs in newspaper advertising and circular letters, with the result that every merchant in the city was willing to talk electric signs, where six months ago it was impossible even to get a hearing.

All this goes to show what a systematic advertising campaign can accomplish, and also, that by persistently, consistently and enthusiastically bombarding the prospect with arguments in favor of what we have to sell, even the most recalcitrant and stubborn prospect can be converted into a profitable customer.

I say profitable customer, because, in my mind, there is no better business for the central station than an electric sign burning its full demand for four hours a day; for where can you find an installation, either inductive or non-inductive, that will give you an income per kilowatt connected per year, as an electric sign?

About the middle of February last we entered into an agreement with the Federal Electric Company of Chicago, whereby it agreed to sell signs to prospects here at a discount of one-third off its list. Our company in turn paid the Federal company for the signs at a forty per cent discount, thus leaving the difference between the two discounts to cover freight, cartage, and the risk involved in carrying the accounts, and we then gave the customer the same plan of payment as we did with the signs made by ourselves.

This put new life into the sign business, as the Federal Electric Company sent a salesman here to canvass the city, with the result that in three weeks nineteen signs were sold, bringing in a revenue of over $1,300 per year.

Toledo Railways and Light.

Plans for the protection of the interests of the Toledo Railways and Light Company have been made public. The formation of a stockholders' protective committee, consisting of William E. Hutton, chairman; Joseph F. Demars, Jay K. Secor, F. H. Goff and J. N. Spencer, has been announced, and stockholders requested to deposit their shares immediately with this committee in order that there may be co-operation with the creditors in plans for refinancing the company in such a way as to care for the indebtedness due or to come due within three months, in all $12,421,960.

An Excellent Free Labor Bureau.

The Bowery Mission Free Labor Bureau is carrying on a worthy work in New York city on behalf of workless but worthy men seeking employment. This bureau is prepared to supply any number of men for any kind of labor at a moment's notice. Within the past twelve months the bureau cashier has paid out $1,453.86 for railroad expenses of willing able-bodied men to all parts of the country. The financial secretary is John C. Earl, 92 Bible House, New York city.

Post Office Business.

The business activities of the busy people of the United States are illustrated by the figures of the Post Office Department, given by the United States Statistical Abstract just published, which show a growth in receipts, chiefly of course from the sale of postage stamps, from practically $1,000,000 in 1820, and $5,500,000 in 1850, to $20,000,000 in in 1870, $33,000,000 in 1880, $61,000,000 in 1890, $102,000,000 in 1900, and $191,500,000 in 1908.

Mexican Telephone and Telegraph Company.

At the annual meeting of the Mexican Telephone and Telegraph Company in Portland, Me., directors were elected as follows: George H. Butters, Lewis C. Benton, B. Nason Hamlin, James Menzies, W. French Smith, H. B. Thayer, and B. E. Freytag, of London, England.

Stockholders authorized the issue of bonds to the amount of $1,000,000 to provide for new construction, and to be issued as required.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

ELECTRICAL DETERMINATION OF MOISTURE IN GRAIN, ETC.

The electrical methods described below of measuring the amount of moisture in grain form a great improvement on the older methods which consume so much time in their application. An electrical instrument has two pointed rods, one of copper and the other of zinc, held in an insulating handle with the protruding points close together and the other ends connected to a galvanometer. These points, when pressed into the germ of a kernel of corn, form in combination with the moisture present in the kernel a voltaic battery. The current generated, and hence the deflection of the galvanometer, depend upon the amount of this moisture. The relation between the deflections and the moisture was determined experimentally and a scale for the galvanometer was constructed therefrom, so that the percentage of moisture in the corn was directly indicated on this scale. Remarkable accuracy is obtained with this instrument. The time required for a test is about three seconds. In the case of wheat and other small grains it is impossible to press the points into the germ. For such purpose the points must be replaced by plates of dissimilar metals, which are pressed into the body of the grain. The grain must first be packed by jarring the vessel and must not have been exposed to air recently, as the drying of the outer coating of the kernels produces great variations in the current due to increased resistance. The large size and the variation in size of the kernels in different samples of corn, make the plates in the bulk give far less reliable values than the method employing the points in individual kernels.

The same apparatus can be used for measuring the amount of moisture in coal, lumber, meal, flour, and in other substances in which the percentage of salt is practically invariable. Another method employs the fact that the resistance of a material varies with the amount of moisture it contains. The resistance may be determined, as by means of a Wheatstone bridge, and the corresponding moisture may then be obtained from a predetermined chart or table.—*Abstracted from The Minnesota Engineer, Quarterly Number for March.*

CO-OPERATION BETWEEN COMPETITORS.

About fifteen months ago a number of German firms connected with different departments of lighting formed a union for the purpose of regulating prices and otherwise co-operating for their mutual benefit. This now includes sixty-six of the largest firms directly connected with lighting by various methods, and also many concerns whose products are used by the lighting firms, as glass makers manufacturing lamp globes, etc. This is typical of the prevailing tendency in Germany toward concerted action in place of the cut-throat competition which is now becoming less common. Another instance in point is the organization of a special annual display at the Leipzig Industrial Exhibition, by a collection of electrical firms of various kinds. In the last exhibition, 1,300 German firms and 210 foreign ones exhibited, and it is anticipated that this number will be largely increased this year. The combined action of the electrical firms mentioned will result in a considerable saving to individual exhibitors, especially in the way of advertisements, propaganda, etc. A special feature of this exhibition will be the concentration of exhibits relating to lighting of all kinds in one building. This is an interesting recognition that illumination is now coming to be looked upon as a subject in itself. It is now recognized that manufacturers of different specialties can be of great assistance to each other. For instance, in an exhibition of this kind, the manufacturers of glow lamps and incandescent mantles, etc., gain an opportunity of co-operating with others who specialize in glassware, shades or fixtures of special character. And it is, of course, of inestimable benefit to the consumer to be able to study all the appliances for illumination in which he is likely to be interested, in one and the same building.—*Abstracted from The Illuminating Engineer (London), for May.*

COMPACTNESS OF TURBO-GENERATOR SETS.

An instance of the extreme utility of a combined steam turbine and generator set where space was extremely limited and where only a slight foundation could conveniently be placed, is furnished by the engineer of a large eastern ship-building and car-works plant. The extra power was urgently needed to meet the growing needs of the shop, and the comparatively small floor area available was not large enough for an engine of any other type. The turbine is direct-connected with two electric generators arranged in tandem, all on the same base. These generators furnish 175 electrical horsepower at low voltage for operating motor-driven machinery. The turbine runs at high speed, but very smoothly and noiselessly, and hence requires only a slight foundation.—*Abstracted from System, for May.*

A NEW ELECTRIC HOIST.

A unique electric hoist has recently been patented by W. P. Robertson, a mining engineer of New York. Compactness is secured by placing the electric driving motor inside the revolving drum, the motor and drum being independently supported. Running through the inside of the drum, and supported by the proper bearings on the upright castings, are four axles upon which are attached eight steel wheels, four on each end of the drum. These wheels support the drum and allow it to freely revolve. The motor rests upon and is firmly secured to steel supports which in turn are firmly secured at each end to the upright castings. The motor drives the internal gear on the drum through a train of gear wheels. The controller and brake lever are conveniently placed directly behind the drum. A number of improvements have been made in this type of hoist in the design of the supporting guide wheels by which wear can be readily taken care of, and in the construction and support of motor by which all parts are made readily accessible.—*Abstracted from The Mining World, April 24.*

ECONOMY OF PRODUCER-GAS ENGINES.

Results from a western candy factory show the producer-gas engine in a very favorable light as compared with the steam engine. In this factory two fifty-horsepower gas engines and producers furnish the power. Buckwheat coal at

$3.25 a ton and pea coal at $4.80 a ton have been used in the producer. Under a combined load of eighty-one horsepower the results of three tests last winter showed a consumption of one-and-one-quarter pounds of coal per horsepower each hour. The vertical steam engines which these gas engines replaced consumed ten pounds of coal per horsepower each hour, although in this connection it is only fair to mention that with the gas engines a low-pressure boiler in addition was necessary for heating, the coal consumption of which is not included in the above figure. In another instance the producer-gas engine showed infinitely better results than a gasoline engine. This was in a flour mill where the cost for gasoline averaged $8 for a ten-hour run, while with a producer-gas engine the coal cost was only $1.35 for coal for the same run. The producer-gas engine, which developed thirty-five horsepower, required a gallon of oil a day for lubrication, and even this small amount was filtered and used over again with good results. These results foreshadow a great increase in the use of the producer and gas engine plant. *Abstracted from Factory for February-March-April.*

THE LITERARY SIDE OF AN ENGINEERING EDUCATION.

The necessity for the engineer to develop in the course of his training a clear, concise and easy style of writing can hardly be overestimated. A gratifying feature of our engineering schools and colleges is the recognition they are now giving to the study of English composition, literature, rhetoric and similar subjects hitherto not considered as part of an engineer's education. Every engineer will find it necessary to prepare and present reports, read papers before scientific bodies, and enter into discussions; and how much more effective would be his statement of facts if they were presented clearly, concisely and without hesitation. In no other profession is the faculty of clear writing and effective speaking of more value than in engineering. To be able to think clearly and to express one's ideas connectedly when upon one's feet in the presence of men somewhat familiar with the subject in hand requires not only knowledge, but practice. And the successful engineer will be able to turn many a difficult situation to his advantage if he can present pleasantly his views to his assembled clients.—*Abstracted from The Canadian Engineer (Toronto, Can.), May 7.*

ELECTRICITY AS APPLIED TO LAUNDRIES.

This was the title of a paper read by B. W. Gilmour at a recent conference of the Scottish Laundry Association, held in Glasgow. Mr. Gilmour said that electricity as a motive power in laundries is not as cheap as steam, because of the large quantity of steam required in a laundry for heating and boiling purposes, a circumstance which affects the relative costs. On installing motors live steam would have to be used for drying and heating in place of exhaust steam. The advantages of electricity are reduction of the dust, simplicity of starting and stopping the machinery, and smallness of the space occupied, besides obtaining a more steady drive from motors. The only department in which electricity as a heating power can at present be applied to laundries is in hand ironing. The extra cost over gas is so little that it is not worth considering, while electricity has the advantages of cleanliness, concentration of heat on the required part, and absence of smell.—*Abstracted from The Electrical Review (London), May 7.*

THAWING OUT EXPLOSIVES BY ELECTRICITY.

One of the most recent instances of the confidence with which electricity as a heating agent is becoming to be regarded is evidenced by the employment of an electric heater for thawing explosives at the Roosevelt drainage tunnel in Cripple Creek, Colo. The support for the wiring of this heater consists of two twelve-inch by twenty-four-inch rectangular frames made of one-and-a-half-inch by quarter-inch iron, held apart three inches vertically and supported on legs above the floor. Telephone insulators spaced on one-and-one-half-inch centers are placed around the sides of each frame, and between each corresponding pair of insulators ordinary coils of galvanized telephone wire are strung, all the sets of wires being connected in series. The coils are heated by the electric-lighting current, and in about thirty minutes warm the small powder house, four feet by five feet in ground plan and six feet high, to a temperature of eighty degrees Fahrenheit. The cost of this method of heating is about ten cents per twenty-four hours, and is said to be far more economical than if coal were used for fuel.—*Abstracted from The Engineering Record (New York), May 15.*

COAGULATING LATEX BY ELECTRICITY.

A novel machine for coagulating latex by electricity has been invented by Thomas Cockerill, of Ceylon. A graphite-coated endless belt forms when electrified a continuously moving anode. A metal cathode hangs about half an inch over the surface of the belt. The latex is allowed to run down from an elevated tank upon the slowly moving belt where it is coagulated by the electricity, the water running off into drip pans. The rubber film is scraped from the belt and run through squeezing rolls to expel the surplus moisture.—*Abstracted from The India Rubber World, May 1.*

Large Railway Map of United States.

A railroad map of the United States, said to be the largest ever sent abroad, has been shipped by the Chicago, Milwaukee & St. Paul Railway for exhibition at the Golden West and American Industries Exhibition at London. The map is forty-seven feet nine inches long, and thirteen feet six inches high, painted in colors on transparent cloth, and is illuminated by electricity. Twenty transparencies of scenes along the St. Paul are shown.

Dispatching By Telephone.

A general substitution of the telephone for the telegraph by western railroads has proceeded so far as to threaten the abolition of the telegraph in all railroad work except for incidental service. The Atchison proposes to use the telephone entirely for train dispatching and otherwise, except for very long distance. The Illinois Central is equipping most of its main line for the same change, and intends to use the telephone exclusively in time. On the western end of the St. Paul's Pacific extension the telephone is used in dispatching, and it will be used extensively over the entire Puget Sound system. All the other principal lines are making like changes.

Public Service Board in China.

An imperial edict issued at Peking on May 4 places under control of the Board of Communications the railroad, navigation, telegraph and postal departments, with supervision by the Board of Finance.

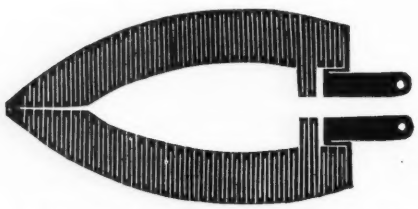
Economic Power Complaint Dismissed.

The New York State Court of Appeals has dismissed the complaint of the Economic Power and Construction Company against the city of Buffalo. The purport of the opinion is believed to be that permissive provisions of the company's charter are unconstitutional.

A New Electric Flatiron.

The General Electric Company has lately brought out a new flatiron, the heating unit of which is new both in material, construction and shape.

The resistance metal used is named by its patentees "Calorite" and is capable of withstanding oxidation to a point several hundred degrees hotter than any metal previously used in heating devices, its melting point being 2,370° F. The resistance of "Calorite" is twice that of nickel-silver and seventy-three times that of copper, and it is this high specific resistance which enables it to be used in a single thin grid-layer or leaf. In the majority of designs the heat must either pass through two or more layers of heat insulation or radiate through an insulating air space. The "Calorite" leaf unit has such close thermal relation to the working surface of the iron that it cannot overheat, which precludes the use of any auxiliary protective device to insure the life of the heating unit.



HEATING ELEMENT, GENERAL ELECTRIC FLATIRON.

In the new iron the heat is evenly distributed over the entire working surface, as shown by scorch proofs taken under working conditions. The body of the iron consists of two hard gray cast-iron plates held together by two heavy steel bolts. The thin leaf unit is firmly clamped between these plates and separated from them only by a sheet of clear amber mica two-thousandths of an inch thick, which provides the necessary insulation.

BODY OF IRON.

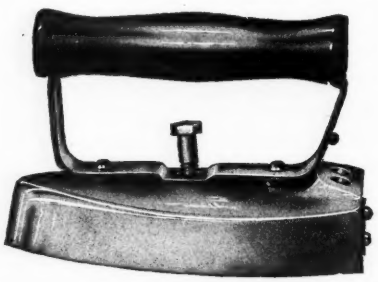
The shell cover, held by one bolt, carries a handle riveted to it, and the usual asbestos is effectively replaced by an insulating air jacket between this shell cover and the working part of the iron, and covering not only the top of the iron but the sides and ends as well.

The use of porcelain is entirely avoided in the attachments, which makes for a practically unbreakable construction.

The leaf-unit flatiron is equipped with plain attaching plug, with combination indicating switch-plug or with permanently attached cord if desired.

The few parts of the iron are readily interchangeable and the iron can be completely disassembled by removing three bolts.

The new iron is available in the five-pound, or 450-watt size, and the six-pound, or 550-watt size. The iron is finished in highly polished nickel.



GENERAL ELECTRIC ELECTRIC FLATIRON.

Sign Lighting With Tungsten Lamps.

A new lamp has been placed upon the market by the various companies of the National Electric Lamp Association which should meet the long-felt demand for a newer and better type of sign illuminant. This new lamp, a low-voltage tungsten sign lamp, consumes but five watts and is rated at 3.75 candlepower. A detailed description of the characteristics, performance and uses of this lamp has been published in Bulletin 6E by the engineering department of the National Electric Lamp Association.

A brief description of the new lamp follows: A substantial V-shaped tungsten filament is mounted in a bulb one-and-three-fourths inches in diameter and three-and-one-fourth inches in over-all length. This bulb is exactly the same size as that of the old four-candlepower carbon sign lamp, and allows the same receptacles and appliances to be adapted for all purposes which were served by the former carbon lamp.

From the illustration, it can be seen that the method of mounting the filament is very substantial. Inasmuch as the lamp has been made for a low potential, *i. e.*, eight to twelve volts, the size of the filament is such that it is not as easily broken as the frailer filament, designed for lamps operating upon higher potential circuits.

It is not possible, of course, to operate these lamps individually on commercial 110-volt circuits. For direct-current systems, it is customary to use a series-multiple system, as, for example, eleven groups in series, each group containing twenty ten-volt lamps in multiple. For alternating-current systems it is better to employ one of the numerous types of sign-lighting transformers or compensators, many of which are now regularly upon the market. These transformers are made for capacities ranging from fifty watts to one kilowatt. In figuring the total wattage of a sign it is necessary to consider the power used up in transformer losses and line losses, due to increased current.

FIVE-WATT TUNGSTEN SIGN LAMP—FULL SIZE.

The majority of these transforming devices have an efficiency of ninety-two per cent and upward at full load, which makes the total wattage consumption of the sign lamp, including transformer losses, approximately 5.4 watts.

Without a doubt, the introduction of this new lamp will be promoted by the increased saving in power consumption, which should be advisable from the standpoint of the central station, inasmuch as the majority of signs are at the present time carried upon a flat-rate schedule. The lamp consumes less than thirty per cent of the energy of the four-candlepower carbon unit.

When energy costs most to produce, that is, at the peak of the daily load curve of the central station, the sign-lighting load, which in the majority of cities is considerable, is usually at full demand. The decrease in this portion of the curve would be more satisfactory to the central station if the sign-lighting load could be appreciably decreased without a prohibitive decrease in income. Any device that will reduce this current eating load of the ordinary carbon sign lamp without a corresponding loss of revenue, should be regarded favorably by the central stations.

The adoption of the new tungsten sign

lamp is equally desirable from the standpoint of the consumer, and a considerably cheaper rate for electric displays, both outline and sign-lighting, should be made possible by the use of tungsten units. A saving of seventy per cent or over in current supplied by the central station would, without a doubt, have an appreciable effect upon the flat-rate at which the station is able to supply the consumer. It is therefore evident that the universal adoption of the new sign lamp should be very satisfactory from the standpoint of both supplier and the supplied.

A New Electric Sign.

The Moray electric pointer sign, patented April 20, 1909, is designed to economize in the use of current, by having only two lights to furnish the illumination, these being contained in a reflecting hood, shaped like the cuff of a man's coat, the sign being the shape of an index hand, and made of white enameled iron. Special reflectors are added to increase the illumination, but the inventor, G. E. Moray, claims that, without any auxiliary reflectors at all, two twenty-five-candlepower lamps will afford better illumination of the lettering than is usually produced by twenty-four eight-candlepower lamps placed around the lettering in the usual manner.

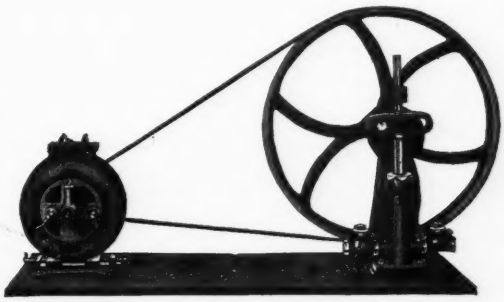
MORAY ELECTRIC POINTER SIGN.

Other advantages that the inventor claims are light weight, weatherproof construction, increased size of lettering space, attractive appearance of the complete sign, and low cost of operation.

These signs are manufactured by the Index Sign Company, Incorporated, 339 East Thirty-Fourth Street, New York.

Electric-Driven House Pump.

The Jarvis Engine and Machine Works, of Lansing, Mich., are now placing upon the market the "Jarvis" electric-driven house pump. These compact little pumps run in price from $12 up and are made with capacities for seventy, 150, 300 and 600 gallons per hour, and are specially adapted for use in houses beyond the reach of the city or town water supply, yet where the lighting services of the central station reaches, for pumping house tanks from wells and cisterns from power furnished by small electric motors which are belted to the pump. It would be well for central-station managers to furnish their customers in the outlying districts with circulars regarding these pumps, which may be automatically controlled, which have proved themselves not only a great convenience, but an outlet for more current from the central stations.



"JARVIS" ELECTRIC-DRIVEN HOUSE PUMP.

The installation shows one of these little units all ready for installation.

All particulars and prices may be had by addressing the manufacturers.

Marshall Molding Receptacles.

The Marshall Electric Company, Hyde Park, Mass., has just brought out a new line of molding receptacles which would seem to completely cover the requirements in this field.

They are in exterior design much the same as other receptacles, but the socket is much stronger, being built into the heavy outer porcelain instead of on a frail base block.

MARSHALL PORCELAIN MOLDING RECEPTACLE.

MARSHALL PORCELAIN MOLDING RECEPTACLE.

The device is very quickly wired and has been highly commended by construction men who have used it.

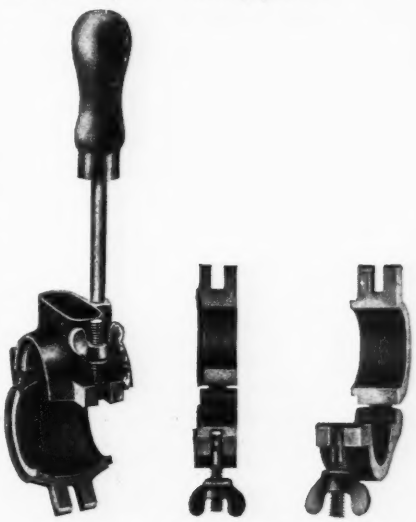
No. 50724 is the plain receptacle and No. 50726 the shade holder.

The Corcoran Wipe-Joint Machine.

The Corcoran wipe-joint machine is designed for wiping any kind of lead joint, whether for high-pressure water connections, waste-pipe connections, brass ferrules or electric-light and telephone cables. It will wipe branch joints as readily as straight, and horizontal joints as readily as vertical.

So easy is the Corcoran wipe-joint machine to operate that anyone of average intelligence can wipe a perfect joint after the first trial, turning out from twenty-five to thirty-five perfect joints a day, using only about half as much metal as a skillful hand wiper, without waste of solder.

While a good cable wiper will wipe four joints a day by hand, with the Corcoran machine for wiping electric-light and telephone cables an ordinary helper can wipe from twenty-five to thirty joints.



CORCORAN WIPE-JOINT MACHINE.

Not only does the Corcoran wipe-joint machine save time, stock and labor, but as the metal can be poured hotter, it fuses better with the lead, making stronger, neater and more perfect joints than can be made by the old hand method.

So vastly superior are the joints wiped by the Corcoran machine that the Cleveland waterworks will not allow a joint to be put in the ground which has not been wiped by this machine.

The machine is made by the Corcoran Wipe-Joint Machine Company, Detroit, Mich.

Babcock Electrics.

The general features and construction of the electric vehicles manufactured by the Babcock Electric Carriage Company, Buffalo, N. Y., were briefly described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of April 10 last. This present article describes in detail some of the principal models of "Babcock Electrics."

The Model 5 Runabout is illustrated in Fig. 1. This car weighs about 1,600 pounds and has a wheel base of seventy-eight inches. There is a one-half platform spring in front and a full elliptic spring in the rear. The chassis is of a special design and is made of wood reinforced with steel plates. The battery, which is made by the Babcock company, is divided, and contains eighteen cells in front under the hood and eighteen cells under the back of the body. It is readily accessible without removal from the body. The motor is suspended from the chassis under the seat and is capable of developing from twelve to fifteen horsepower. The driving gear is of the double-chain variety, remarkable for its flexibility and noiselessness. The specially designed controller, with five speeds forward and two reverse, is fitted with a safety foot control, thus greatly minimizing the possibility of accidents. Raymond brakes are provided in the rear hubs, and an auxiliary brake on the countershaft. The car is painted in maroon and is upholstered in leather to match. The top is of leather and the side curtains of rubber, all waterproof. The Model 5 Runabout will develop a speed of from six to thirty miles an hour on the level and is a splendid hill climber. This is the car that made the 100-mile run from New York to Philadelphia in 1906 on a single charge of the batteries.

The Model 6 Victoria Phaeton is shown in Fig. 2. This luxurious and stylish electromobile is specially recommended for ladies' use. The low hang of the carriage greatly facilitates entry and exit and the continuous mudguards effectively protect the clothing from the wheels. The wheel steer is provided with a braking joint, so as to permit of ingress or egress from either side. The seat is made very roomy yet without sacrificing any of the light and artistic features of the car. The chassis is of armored type, the wheel base seventy-eight inches, and the springs half platform in front and full elliptic in the rear. The car weighs about 1,750 pounds. Driving gear, motor, brakes, and controller are about the same as those of the runabout described above. Speeds are from six to twenty-five miles an hour. The great mileage capacity and the ease with which it can be guided through city traffic make the Victoria Phaeton an ideal car for social and business purposes.

The handsome Model 10 Coupé, illustrated in Fig. 3, is extremely light and roomy, and the finish and appointments are unexcelled. In its closed condition it is an ideal car in inclement weather, while in warm weather it can be made as airy as an open car by simply lowering the windows. The seat is forty-five inches wide, providing ample accommodation for three persons, and there is, besides, an extra folding front seat. This car is practically identical with Model 6, except for the body, and the bodies of both cars are interchangeable one with the other. The Coupé weighs about 1,750 pounds and the mileage is from sixty to seventy miles on good roads. The finish is in royal blue with upholstered broadcloth to match. The top is of leather. Besides the speedometer, voltmeter, ammeter, and

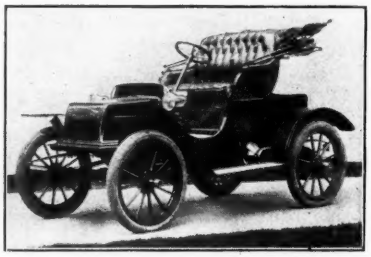


FIG. 1.—MODEL 5 RUNABOUT.

a tool outfit with which all the Babcock Electrics are equipped, this car is also provided with a dome light, card case, mirror, watch, and perfume bottles. Indeed, no feature is omitted that will make the Model 10 Coupé the de luxe car of electric automobilia.

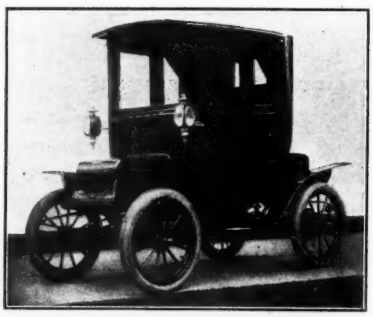


FIG. 2.—MODEL 6 VICTORIA PHAETON.

The Model 12 Roadster, shown in Fig. 4, is almost indistinguishable from a smart gasoline car, and, indeed, were it not that the troubles of cranking, ignition, carburetor, radiation, lubrication, etc., of the internal-combustion-engine car are all eliminated, the resemblance would be complete. The wheel base, ninety-two inches, is exceptionally large for an electric car. The fifteen-horsepower motor will develop a speed of over thirty miles an hour, and at a speed of seventeen miles

FIG. 3.—MODEL 10 COUPE.

an hour the forty-two-cell battery will give a radius of 100 miles on a good level road. The weight of the car is 2,200 pounds. The mechanical features are about the same as those of the cars previously described. The car is finished in

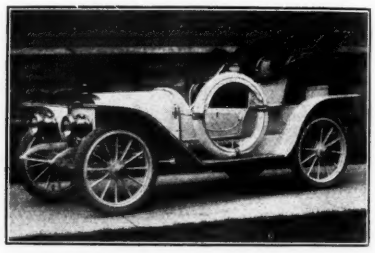


FIG. 4.—MODEL 12 ROADSTER.

ivory white with gold stripes. Upholstering is of red leather, and the top is of red pantasote. Dicky seat, glass front, and a spare tire are provided as extras.

Water Filtration for Steam Boiler Users.

One of the newest developments of interest to steam users in general is that of the Oliver-Roche system of water purification, exploited by the Municipal Filtration Company, Ford Building, Detroit, Mich., which not only does away with foaming and priming by the removal of all insoluble matter, but prevents scale by the neutralization of the carbonate of lime and magnesia, thereby removing the adhesive properties.

These results are accomplished without the use of chemicals or compounds of any description. The system is long past the experimental stage, having handled such waters as the sulphur-laden mine waters of Pennsylvania, the filthy waters of Buffalo Creek, Buffalo, N. Y., where one of the purifiers has been in

constant operation for the past two years, the lime waters of DeWitt, N. Y., and other places too numerous to mention. In developing this system the owners have endeavored to make it fail by putting it to the most difficult tasks at all times.

The question of the loss in steam efficiency, through the use of so-called "hard water" or of water in which the impurities cause foaming and priming of boilers, has been given a great deal of attention, not only by engineers, but by chemists, and inventors; still very few people thoroughly appreciate what a loss is caused by scale.

Taking fourteen grains of deposit per gallon as a basis, the amount of scale deposited in a 1,000-horsepower boiler plant, operated for thirty days at twelve hours per day, would be upward of 1,500 pounds. Taking fourteen grains to the gallon is conservative as analyses from several points, run above twenty grains, and some run as high as 104 grains per gallon of incrusting solids.

While the resultant scale, in all probability, would not be increased in ratio to the increase of incrusting solids, it can readily be seen that even five times the amount estimated at fourteen grains would bring a deposit of from 6,000 to 7,500 pounds of scale per thousand horsepower capacity for thirty days.

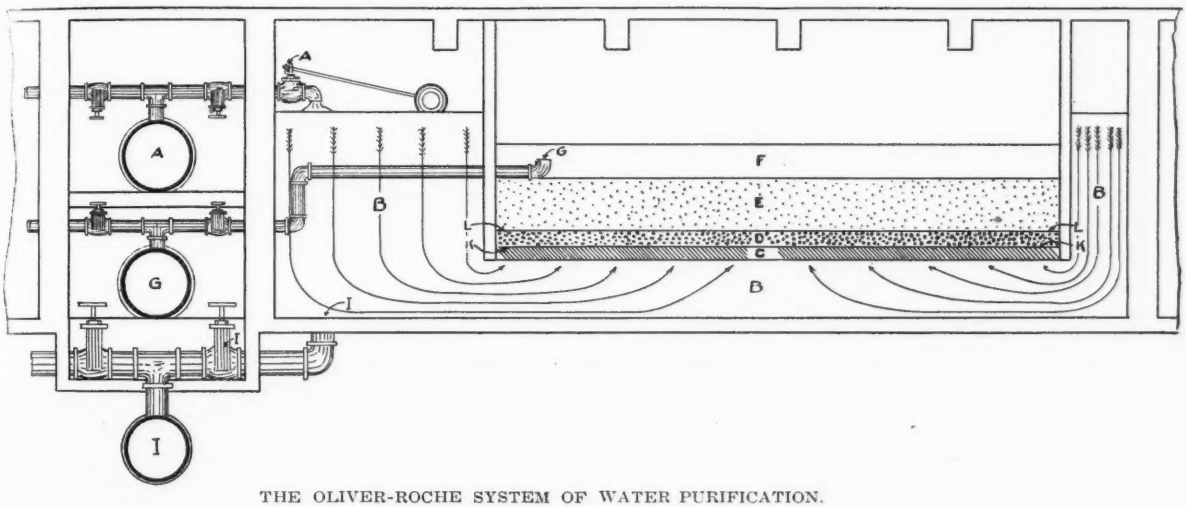
The loss in fuel efficiency is but two per cent at one-sixty-fourth inch of scale, while at three-sixteenths (which is common) there is a loss of twenty-seven per cent, and at one-half inch 60 per cent. In view of the fact that three-sixteenths inch is common that will be taken as a basis.

Basing the fuel saving of a 1,000-horsepower boiler plant having an average of three-sixteenths inch of scale, and using coal at $2.50 per ton at the boiler house, as a fuel cost, there would be an annual saving of $4,434, these figures allowing only three pounds of coal per horsepower-hour. This saving is exclusive of that made in saving of cost of compounds, low service efficiency and abnormal repairs, and is made possible by the installation of a system of which the initial cost is less than the fuel saving alone for one year, and carries with it a maintenance contract which on this size of unit is approximately five per cent of its cost.

The Oliver-Roche system is installed under such strong guarantees that the question of always having the purifier open to the inspection of their representative, and all repairs and upkeep to be looked after by them, was found to be the only possible way of giving at all times the highest class of efficient service.

The illustration herewith gives a clear idea of the method of operation, showing the upward percolation and the downward sedimentation. "Nature's process" is helped out by the introduction of the elements necessary, the strata being changed to conform to the needs of the water treated, the depth being decided by the chemical analyses of it, and these analyses are made for any prospective customer free of cost.

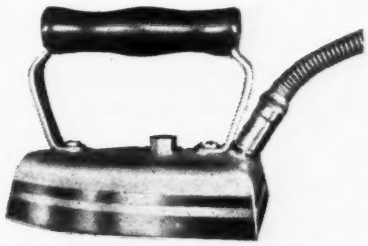
Two rather remarkable cases are of interest here: One was on a dredge in Buffalo Creek, Buffalo, N. Y. It was impossible to get water from the shore to the dredge and the limit of operating time was three hours, as after being in operation for that length of time the boilers foamed so badly it was impossible to run without shutting down and blowing them out. After the installing of one of the purifiers they run constantly with no boiler trouble of any kind, and at a great fuel saving. Another was of a boiler which it was found impossible to run at an efficient point; one of the purifiers was installed, and at the end of twenty-nine days the pure water had so disintegrated the deposit in the tubes that 2,250 pounds of scale were removed, and a boiler put in operation at the time the purifier was started was clear of all deposit, as shown by a very critical examination. These cases are remarkable, as there were no chemicals of any kind introduced to assist the purifier in its work.



THE OLIVER-ROCHE SYSTEM OF WATER PURIFICATION.

The "Harwood" Electric Iron.

An electric iron, in which the entire bottom of the iron might be called the heating element, has been brought out by the Harwood Electric Heating Company of Hutchinson, Kan. The bottom of this iron is a heavy piece of cast-iron, one side of which is the polished working surface,



HARWOOD FLATIRON.

the top side having slots cut in a raised portion of the solid metal, the resistance being imbedded in these slots so that the heat is all generated right in the bottom of the iron, where it is needed. The solid mass of metal in the bottom of this iron will maintain a constant even temperature

for a considerable length of time even though the current be turned off. Yet this iron will rise to a working temperature quickly because the heat is all generated in, and confined to the metal of the working surface. The resistance material is in such perfect contact with the body to be heated that it cannot become much hotter than the working surface. The resistance material is placed in the iron in such a manner that it is not subjected to any strains caused by the expansion or contraction of the metal composing the body of the iron, thus making the "Harwood" iron practically free from the possibility of burn-outs.

While considerable advance has been made during the last two years in the construction of the heating elements for electric irons, little has been done to improve the method of making the electrical contact with the iron. The old-style switch plug has caused untold trouble because of the fact that the contact parts, being subjected to considerable heat, would soon lose their temper and become loose, thus causing the current to arc and burn the contact parts until they were useless. The Harwood Electric Heating Company, realizing that the switch plug was the weakest point in their iron, conducted a series of experiments until they recently perfected a new switch plug that is radically different from anything heretofore made. Instead of depending entirely or partially upon the spring of the metal composing the contacts they have provided heavy spiral springs between the porcelain insulating parts and their novel metal case which protect the switch plug from breakage. The floating contacts being backed up by these heavy independent springs, which are not affected by heat, insure a perfect contact their entire length at all times, thus eliminating all trouble from loose contacts.

A New Form of High-Tension Crossing-Protector.

Various methods have been successfully tried out for preventing high-tension transmission lines from coming in contact with other lines under abnormal conditions, such as presented by broken wires, fallen poles, etc. Chief among these are suspended networks and the use of high poles. The former is unsightly, while both are comparatively expensive.

To obviate the disadvantages of the old systems and to secure the desired factor of safety, the General Electric Company of Chicago, Ill., has developed the high-tension drop-out span crossing-protector, illustrated in Fig. 1, a complete installation being shown in Fig. 2. While this is comparatively new it has already been tried out on some very important transmission systems and has proved to be not only a most economical but also a most practical solution of the crossing problem.

The protector comprises two elements, one an inverted spoon-shaped casting to be rigidly attached to a line insulator on the pole, and the other a movable, hook-shaped contrivance engaging with it. This is shown in Fig. 3.

The device is connected directly in series with the line and the current flowing in the wire passes directly through the span protector, as will be seen from Fig. 3. The point of contact is made in a ball and socket joint, thus assuring perfect alignment and electrical contact. Tests have shown that resistance of the drop-out span-protector is less than the equivalent length of wire which it replaces.

The operation of the device is obvious, that is, a breakage in the line wire immediately causing the span-protector elements to disengage, with the result that the entire span falls to the ground absolutely dead, thus preventing the high-tension wires coming into contact with the underneath crossings.

It has been proved by actual test that in the case of a break in a high-tension line the additional weight of the drop-out span-protector on one end of each of the two falling pieces insures that the broken wires rattle down through the telephone, telegraph or other lines instead of lodging on them and causing trouble, as is frequently the case with suspended networks.

To meet the requirements of modern service the protectors are manufactured to fit the various types of insulators found on the market and are made in various tensile strengths and carrying capacities. The protectors can readily be installed on an existing line, requiring practically no departure from the standard construction used on the system; in fact, most users build a line and cut in the protectors after the line is completed and the wire drawn up.

The protectors are made in both top-tie and side-tie forms, the first being adapted for mounting on top of the insulator and the second on the side groove of the insulator. The two types of top and side-tie protectors are again divided in two classes, the first consisting of a single-break device for opening up a single section of span and the second consisting of a double-break device which will open up the sections of both sides of the pole on which it is installed. The double-end protector is largely used for two adjacent lines that are to be crossed, and where they are not sufficiently close together to permit the use of one span over the crossing. They are also used in certain cases where the lines to be protected are unduly close to the transmission line pole.

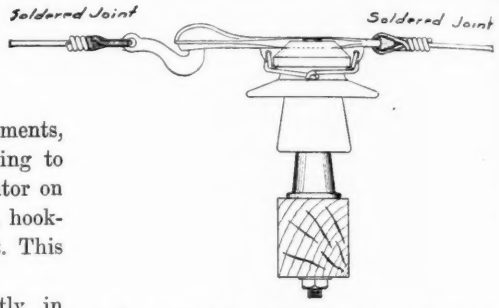


FIG. 1.—HIGH-TENSION DROP-OUT SPAN CROSSING-PROTECTOR.

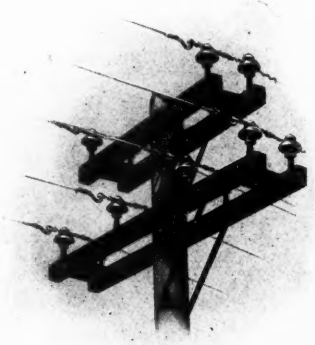


FIG. 2.—COMPLETE INSTALLATION HIGH-TENSION CROSSING-PROTECTOR.

FIG. 3.—DETAIL OF CROSSING-PROTECTOR SHOWING GROUND BALL JOINT.

Telephone Contract Void.

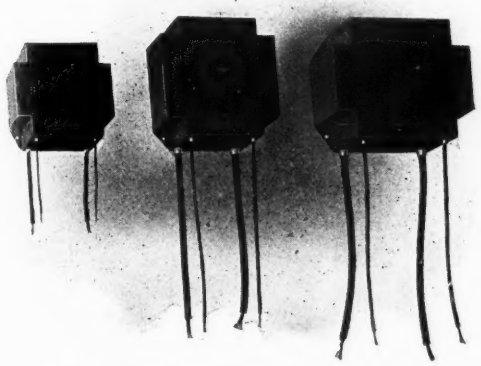
On the ground that it would restrain trade, Judge R. W. Tayler, of the United States Circuit Court, at Toledo, Ohio, has dissolved the temporary restraining order and denied an injunction in the case of the United States Telephone Company against the Central Union Telephone Company and the American Telephone and Telegraph Company.

Packard Tungsten Sign-Lamp Transformers.

The Packard Electric Company, Warren, Ohio, has designed and placed on the market a full line of special transformers to meet the new conditions of sign-lamp service, with the new tungsten low-voltage lamp.

These instruments are neat in appearance, compact, and as light in weight as is consistent with good economy. They can be attached to the sign itself, which eliminates voltage drop in the low-voltage leads.

The transformers are designed to give an exact ratio of ten to one under full-load conditions, insuring full potential at the lamps, and therefore, full candle-power. These transformers are controlled through the primary circuit, so that when the sign is not illuminated the small transformer loss is entirely eliminated.



PACKARD SIGN-LAMP TRANSFORMERS.

These transformers are not made on the auto-transformer principle, but are designed with separate primary and secondary coils amply insulated from each other. The vacuum drying and impregnating system of insulating is used, as with the standard transformers made by the above-mentioned company. The case is made of leaded sheet iron and is entirely filled with solid compound of high heat conductivity. The cases are sealed in place to exclude moisture, and all leads are carried out through strong porcelain bushings, each carefully sealed in.

Reorganization of United States Light and Heating Company.

The United States Light and Heating Company has been recently incorporated under the laws of the state of Maine and has secured control of the National Battery Company of Buffalo, N. Y., the Bliss Electric Car Lighting Company, of Milwaukee, Wis., and the United States Light and Heating Company, of New Jersey. The new company has been capitalized for $17,500,000, and its board of directors consists of the following well-known men: Edwin Hawley, chairman of board, Chesapeake & Ohio Railway; William H. Silverthorne, president Railway Steel Spring Company; Jules E. French, chairman board of directors Railway Steel Spring Company; Theodore P. Shonts, president Interborough Rapid Transit Company; Newman Erb, formerly president Wisconsin Central Railway; Charles A. Starbuck, president New York Air Brake Company, and Walter S. Crandell, secretary and treasurer. The officers of the company are: W. H. Silverthorne, president; Jules E. French, first vice-president; Edwin Hawley, second vice-president; C. A. Starbuck, third vice-president; W. S. Crandell, secretary and treasurer; J. Allan Smith, general manager.

The acquirement of the above-named properties has secured to the United States Light and Heating Company of Maine the control of the important basic and detail patents covering the art of passenger-car electric lighting and storage-battery-manufacture processes and regulation, as well as passenger-car heating. It is the intention of the company to erect a large new plant at Buffalo or Niagara Falls, for the manufacture of storage batteries for every purpose, especial attention being given to the railway-car lighting field. This plant, when completed, will probably be one of the largest of its kind. It is also understood that the plant of the Bliss Electric Car Lighting Company, as well as that of the United States Light and Heating Company, will be continued in operation for the manufacture of automatic apparatus and systems for railroad passenger-car lighting, and heating equipments and accessories. With the increased factory facilities, and the establishment of district depots and storerooms, together with the increased number of general agencies, extensive facilities will be provided so as to insure prompt attention to all inquiries for apparatus, material or engineering advice, thus obviating costly and annoying delays. It is the intention of the management to keep in immediate and personal touch with customers and users of the various apparatus manufactured by the company. The combined engineering forces brought together will be at the disposal of railroad companies, central stations and users of storage batteries in general.

The well-known National batteries, which have been greatly improved throughout the wide range of central station, vehicle, sparking and car-lighting lines, are the result of years of active experience in this field. The various types to be exploited include all types of assembling, as well as all acceptable types of plate structures and formations and combinations thereof, such as composite batteries with Planté positives and pasted negatives, pure Planté batteries with both elements consisting of pure Planté plates, or Faure batteries in which both elements are pasted, all depending upon the purposes for which they are to be used and their adaptability thereto.

The "Unit" plate, designed for central-station and heavy power work, consists of a number of units of pure lead, secured to an antimonious lead frame by means of autogenous welding. Space is allowed each unit for the natural growth which takes place in the positive plate. The units have an electrical contact with supporting frame; consequently the internal resistance of the plate does not increase with age, thus enabling the reserve lead in the units to be utilized and thereby guaranteeing long life with retained capacity.

The negative plate is of the Faure or pasted type. The grid is an antimonious staggered type, from each of the cross-ribs of which protrude a number of pins. When the material shrinks, which is natural, the contact between the active material and the grid is not impaired.

For the smaller types of batteries, the one-piece Planté positive plate is used. This is made by the National swaging process, which is a vast improvement over former methods. This plate is made from a single blank of the densest, chemically pure, rolled lead, and is the most perfect battery mechanically on the market today. The negative plate is of the one-piece Planté type, and as the negative does not require the same mechanical strength as the positive, the center web is omitted, in order to give free circulation of the electrolyte, resulting in maximum efficiency and low charging voltage, a very desirable characteristic.

The car-lighting battery presents the combined experience of the best battery engineers, chemists and designers in this and other countries since the commencement of the art.

Brookfield Glass Insulators.

The Brookfield Glass Company, 2 Rector Street, New York is one of the pioneer and one of the most prominent manufacturers of glass insulators. This company's product has been standard for forty years, and with the Barclay improved insulator a fine range of selection is afforded, meeting every exigency of line construction. The accompanying illustrations show four types of Brookfield insulators. Fig. 1 is a "Combination Safety" insulator, which is designed to prevent the dropping of the line wire to the cross-arm if the tie-wire breaks and to eliminate the necessity of tying to every insulator. Fig. 2 is the "Western Union" double-petticoat pattern. Fig. 3 is the pony pattern, and Fig. 4 the deep-groove, double-petticoat pattern.

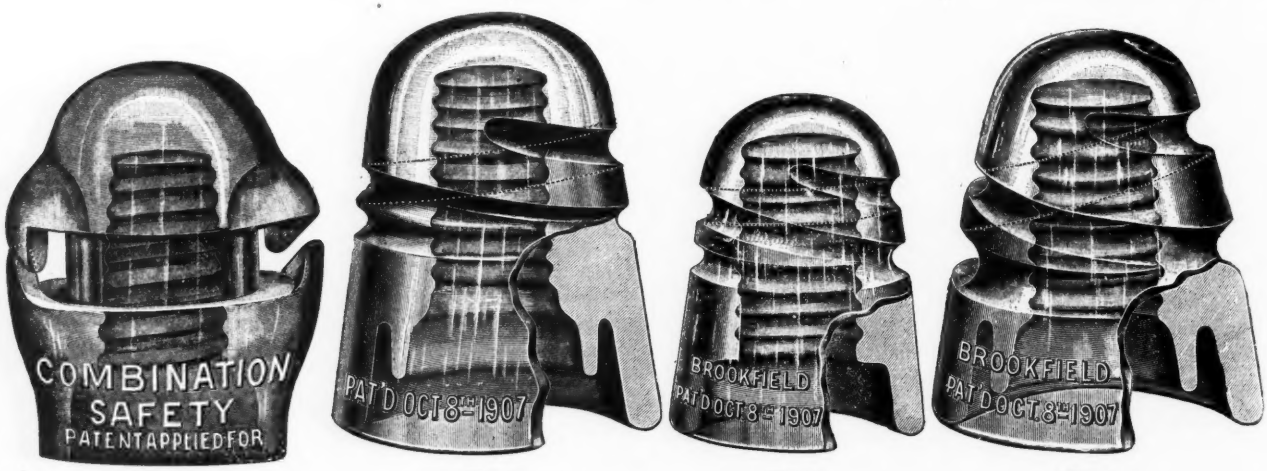


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

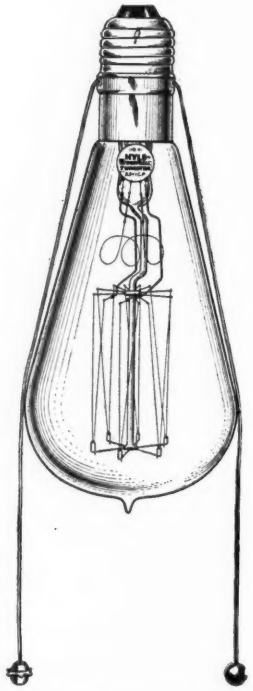
BROOKFIELD GLASS INSULATORS.

With the Barclay improved insulator the spiral groove on the outer surface is so threaded that when unscrewed from its pin the tie holding the wire is also unscrewed or removed from the insulator. The reverse operation screws the insulator on the pin, and at the same time puts the tie wire back in its original position on the insulator. The object of this insulator is to save labor and expense in renewing glass when broken or otherwise defective, and in the transfer of wires from one position on a pole to another, all of which is accomplished without untying or retying the wire.

A Tungsten Turn-Down Lamp.

The Economical Electric Lamp Company, 25 West Broadway, New York, has placed on the market a novelty in the form of a tungsten turn-down lamp. The turn-down lamp has become very popular for use in bedrooms, in hospital wards, on board ship, and in innumerable places where a dim light is required a greater part of the time. The current consumption of the smaller filament is so very slight that in many instances the consumer prefers the turn-down lamp to the ordinary single-filament incandescent.

In this lamp two filaments are connected in parallel, the tungsten filament being made shorter, however, than in the ordinary tungsten lamp. The six-loop



TUNGSTEN TURN-DOWN LAMP.

large filament is of tungsten, consuming thirty-five watts and giving twenty-seven candlepower. The smaller filament is of carbon rated at one-and-one-quarter watts per candle, and the lamp is made for 100-120-volt circuits. The lamp should be used on tungsten fixtures.

The Portable "Positive" Electric Cleaner.

The increased demand for vacuum cleaners, resulting from their adoption by central stations throughout the country as a means of increasing their service, has led the Electric Cleaner Company, manufacturer of the "Positive" electric vacuum cleaner, 1657 Monadnock Block, Chicago, to make a very attractive proposition to the managers of these plants.

THE PORTABLE "POSITIVE" ELECTRIC CLEANER.

The accompanying illustration shows that the entire mechanism is enclosed in a highly polished oak cabinet, which is mounted upon ball-bearing casters. The effective and simple way of separating the dust and dirt from the air appeals to everyone, as does the method of emptying and cleaning the dust drawer.

This machine has been exhibited at most of the recent electrical shows throughout the country, and will be exhibited at the convention of the National Electric Light Association, at Atlantic City, N. J., June 1 to 4.

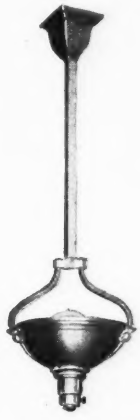
Indirect Illumination.

Indirect illumination, in which a direct glare (as from a clear-glass incandescent lamp) is avoided, has long been acknowledged as the most desirable and comfortable method of illumination.

Bright sources of light placed within the range of vision have a very injurious effect on the eyes, besides causing frequent headaches and nervous troubles as a direct consequence of the eye distress.

A practical method based upon scientific principles and called the "I-Comfort System," has been evolved to rectify the evil effects of direct illumination, and judging by the number of representative firms and corporations that have already made large installations of this system in their offices and shops, it has amply demonstrated the advantages claimed for it by the manufacturers.

THREE-LIGHT UNIT.



SINGLE-LIGHT UNIT.

In this system there is placed in a one-piece glass reflector a tungsten lamp of either sixty or 100 watts capacity. This reflector is suspended from the center of the room (or attached to fixtures already in use) and throws the rays of light to the ceiling at a correct angle, from where it is distributed to the working plane and throughout the room in an even flood of light. The reflector must of necessity be of correct scientific design and of great efficiency. This is secured by having a reflector molded in correct shape, having peculiar circular and vertical corrugations.

This one-piece glass reflector is silver-plated, giving the upward reflection of light without perceptible loss. The ceiling must be of light tint, although not necessarily white. It is a peculiar thing that the majority of ceilings are adapted for this system of lighting. Of course, corrugated iron ceilings, or those with beams in close proximity, are not adapted for this method of illumination.

The reflectors are incased in a very neat brass receptacle, and in some cases are suspended from the ceiling by means of brass chains; in other instances, the units are placed in adaptable forms, and by cleverly devised fittings and adjustables can be applied to many of the standard fixtures now in use.

The accompanying illustrations show some recent fixtures embodying these "I-Comfort" units. The larger fixture can be used with from two to five units, depending, of course, upon the space to be illuminated. The smaller fixture is particularly adaptable for hospital use, as it offers but small surface for the collection of dust and is very easily cleaned. In this respect it will be of interest to know that the surface of the inverted reflector being fire-glazed, it is very easily kept cleaned. All that is necessary is to wipe out the reflector with a dry cloth once every two or three months.

Since the introduction of the "I-Comfort" system of indirect illumination last October through the Illuminating Engineering Society of Chicago, over 1,500 installations have been made, and it is an interesting fact to note that of the thousands of people now working under indirect illumination, almost everyone is an enthusiastic booster of the method. The eye-comfort experienced can only be realized by its use.

Among the installations being made at present might be mentioned the Southern Pacific Company's Hospital, just nearing completion, San Francisco, Cal. Dr. Ainsworth, surgeon in charge, visited Chicago and investigated the "I-Comfort" system of illumination, and has placed an order for the complete equipment of this modern and up-to-date hospital.

That the "I-Comfort" system is economical as well as efficient and pleasing to the eye is evidenced by the fact that the installation of this system in the auditorium of the South Shore Country Club of Chicago will cost less than $1,000 as against $1,600 for direct illumination, using the same amount of current and equally artistic features.

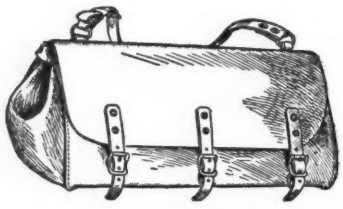
Benjamin Weatherproof Tungsten Arc.

The "Benjamin Weatherproof Tungsten Arc Lamp," manufactured by the Benjamin Electric Manufacturing Company, Chicago, Ill., is a good-appearing and efficient substitute for arc lamps. It has a twenty-inch high-grade porcelain-enameled steel reflector and a twelve-inch glass ball. Above the former is the body portion of copper, a metal cross-arm with porcelain knobs, a weatherproof porcelain connecting block, and a suspension loop. The globe may be suspended and held in position for cleaning and removing the lamps, or may be entirely removed, if desired. This is accomplished by means of a rod passing through the hollow support. It is ventilated at the top and the bottom by holes which are small enough to keep out insects. An inside reflector of white enameled steel, with openings for the lamps, assists in the radiation of light. This and the main reflector are low enough to secure a good distribution of the horizontal rays in a downward direction. The device may be furnished without the upper portion when attached to a gooseneck or other form of suspension where the wires are concealed. It is made with four and five lights and is suitable for lamps with a maximum wattage of 100. The above illustration of the Benjamin Weatherproof Tungsten Arc shows the compactness of this fixture as compared with the usual arc lamp, which it greatly resembles in external appearance, except that it is much shorter.

BENJAMIN WEATHERPROOF TUNGSTEN ARC.

New Tools for Line-Construction Work.

Mathias Klein and Sons, Chicago, Ill., have recently added to their stock of linemen's supplies, line-construction tools and material, a number of new appliances, including a leather tool bag for inspectors and electricians. This bag is made of



TOOL BAG.

russet leather, with welt seams, and is a neat-appearing article. It is provided with extension straps across the ends of the opening, so that it may be widened up when additional room is required. It has three retaining straps on the flap, and loops under the flap for carrying a saw. It is also provided with shoulder straps. This very serviceable bag is made in the following sizes: Sixteen-inch, eighteen-inch, twenty-inch. Another useful tool introduced by this firm is the terminal wrench.

TERMINAL WRENCH.

This No. 63W wrench is especially adapted for use on terminal nuts, receiver, transmitters, and binding posts, etc. There are three different side openings, with dimensions as follows: Three-eighths inch; five-eighths inch; and seven-sixteenths inch, which will engage either square or hexagonal nuts. One end is bent at an angle of forty-five degrees, to allow its use in confined places. Total length, two-and-thirteen-sixteenths inches.

The cost is so small, and the convenience so great, that one usually finds this wrench in every electrician's tool kit.

The firm also draws attention to "Klein's metal pole supporters," which have the advantage of lightness and strength, and a smaller diameter of the uprights, making them more convenient to handle, and allowing the follow-up man to work with more agility than with the wooden pattern. Furthermore, being of metal, they are not warped and twisted and weakened by exposure to the weather, and are practically indestructible. The flange at the foot prevents the support from sinking into soft ground. They are made in the usual sizes, viz., six feet, seven feet and eight feet.

The new steel tie and splicing wrench made by Mathias Klein and Sons is also worthy of particular attention. The purpose of this wrench is to "tie in" the line wire to the insulator. In practical use the tie wire, already bent in the customary V shape, is slipped over the insulator with the open end of the V resting on the line wire; then one of the ends of the V is put through the hole in the eye, and the tool shoved back against the line wire. Then, by a rotary movement of the wrench around the line wire, it curls the tie wire around the line wire in the form of a spiral. The other end of the V is then treated likewise, and

METAL POLE SUPPORTER.

the line is permanently fastened to the insulator. Linemen ordinarily do this work with pliers, but the Mathias wrench is a time-saver, and makes a clean, solid

METAL POLE SUPPORTER.

job, without danger of nicking the line wire. The splicing end is intended for use along with the splicing clamp. The ends of the wires to be connected are held with the splicing clamp, and the projecting end is caught with the shoulder of the wrench, and by turning the wrench around continuously it will coil the wire tightly and evenly on the line wire, making a clean tight splice. It is made in the following size wires for tying in with Nos. 7 to 11 copper wire, and splicing

SPLICING WRENCH.

Nos. 4, 6, 9, 10, 12 iron wire, or for Nos. 2-4, 6-8, 10-12 copper wire. The wrench measures seven inches over all.

The Latest G. E. Tungsten Sign Lamp.

To central stations interested in sign lighting, particularly on flat rates, the new G. E. sign lamp is proving a very attractive proposition, as evidenced by the number of large orders that have already been placed for this lamp.

This lamp is an interesting development of the tungsten lamp, which is made in low voltages, eight, ten, and twelve volts, consuming five watts, and rated at four candlepower.

The high efficiency of the tungsten sign lamp gives point and brilliancy to a tungsten-lamp sign that is in striking contrast to the ordinary carbon-lamp sign. This new lamp will doubtless greatly promote the popularity of electric signs, not only by making them more attractive, but by making it possible to reduce the cost of such service.

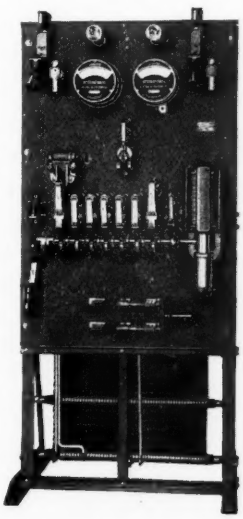
The new G. E. tungsten sign lamp can be operated on alternating-current circuits in multiple on special sign transformers which the General Electric Company is now building for reducing the ordinary 100-130 volts to the tungsten sign-lamp voltages. As sign lamps generally operate in banks and burn continuously, the transformer is carrying full load or none at all, and can be cut off when the sign is not in use. The sign transformer can therefore be operated at a very high efficiency. The lamps may also be operated in series on circuits of standard voltages. Lamps selected for uniform amperes are supplied for this service when intended for series operation.

This new lamp has a very sturdy V-shaped filament, well supported by an anchor, and will burn in any position, and, it is estimated, will give an average life of 2,000 hours. This really is a very special point in regard to this lamp, because the saving of fifteen watts per lamp

Starter for Motor-Driven Fire Pumps.

The type "EH" starter, manufactured by the J. L. Schureman Company, Chicago, Ill., and described below, is designed primarily for the control of motor-driven fire pumps, and finds its widest use in connection with centrifugal underwriters' pumps operating on sprinkler systems. Its purpose is to start and stop the pump automatically on variations of pressure in the system, thus maintaining a constant pressure available in case of fire.

The illustration shows one of these starters complete, with accessories, including circuit-breaker, ammeter, voltmeter, main-line knife-switch, etc., for controlling a 100-horsepower, 220-volt,



J. L. SCHUREMAN MOTOR STARTER.

motor-driven underwriters' fire pump recently installed in Chicago.

The apparatus consists simply of a combined line switch and rheostat, so designed that it can be operated both automatically and by hand. The main-line and accelerating switches consist of a series of switches closed mechanically and successively by means of cranks on a revolving shaft. This shaft is revolved either by a solenoid through the medium of a rack or pinion, or by a hand lever.

A pneumatic governor, connected to the pressure tank into which the pump discharges, controls the circuit of the solenoid, opening and closing this circuit on predetermined limits of pressure, thus energizing and de-energizing the solenoid to start and stop the motor automatically.

To start the motor by hand, the lever at the end of the shaft is gradually raised to a vertical position, thus revolving the shaft through half a revolution, closing the switches in succession and bringing the motor to speed. The lever is held in the running position by a retaining magnet, thus providing the no-voltage-release feature. Upon failure of voltage the lever and solenoid plunger drop to the off position, opening the switches, reinserting the armature resistance and opening the motor circuit.

The crank switch, which is used to make and break the motor circuit, consists of a laminated brush with auxiliary carbon contact, and is provided with a powerful blow magnet to disrupt the arc. The accelerating switches have heavy "butt-end" carbon contacts, and all burning and arcing is practically eliminated. The solenoid plunger is retarded by means of a vacuum dashpot, which may be easily adjusted to govern the rate of acceleration of the motor.

In some cases it is desired to provide for a speed-regulating feature for increasing the speed of the motor ten per cent over normal, thus increasing the capacity of the pump in case of emergency. For this purpose a single-magnet switch, controlled by push-buttons on the panel, is provided, which inserts the required resistance in the shunt field of the motor. The circuit of this switch is controlled by the rheostat in such a way that it is impossible to start the motor with weakened field.

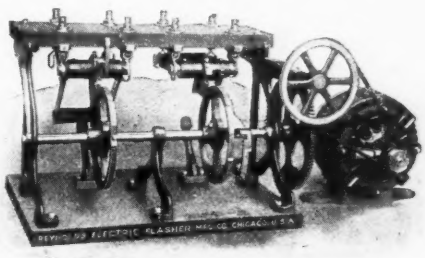
The advantage of this type of starter for fire-pump service lies in its extreme simplicity. The entire automatic feature is controlled by one coil, and the hand operation is accomplished by means of one lever. Furthermore, the same rheostat contacts and resistance are used for both operations, and at the same time either control is absolutely independent of the other. All sliding contacts and delicate relays are eliminated entirely, and the rugged construction and simplicity of operation make the outfit ready for action under all conditions.

The increasing use of electric pumps for fire-pump duty makes this apparatus of particular interest at the present time.

The New Reco Flasher.

The Reynolds Electric Flasher Manufacturing Company, of Chicago, has brought out a new improved type of sign flasher. A view of this flasher as built for two twenty-ampere circuits is shown in the illustration. Each of the double-pole switches is rated at twenty amperes, at 110 volts. These switches have the patented self-lubricating jaws, which have been a feature of Reco flashers for some time. The jaws are U-shaped, being turned back in such a way as to form a pocket for grease. This grease is fed to the contact surface through a slot in the switch jaw, and when once lubricated in this way the flasher will operate a long time without additional lubrication. The top and bottom slabs of the flasher are of slate. Switches for controlling larger circuits are constructed of proportionately heavier copper.

An important feature of this flasher is the provision made to prevent the various parts from working loose, as a flasher must operate continuously for long periods without attention. The switch terminals and binding posts in the upper slab have rectangular channels milled in the slate, into which the terminals fit closely, so that they cannot turn and work loose. There are also channels milled out to receive the iron frame which supports this top slab. These channels, however, are only in the corners, and do not extend clear across the end of the slab so as to weaken it. The bearings are made by boring holes directly in the iron standard, as the speed of the shaft is very slow



"RECO" FLASHER.

and the complication of special journal boxes not desirable. The worms and gears are machine cut.

The operation of opening and closing the switches is accomplished by a new and specially designed form of mechanism in the following manner: An iron dog attached to a hard-fiber switch axis engages a case-hardened tooth on the wheel which operates the switch. The tripping of the mechanism is accomplished with this tooth. The wheel carries a sector which engages with the dog and causes the switch to open instantaneously, thus avoiding undue arcing.

The New Reco will produce any desired effect, from flashing whole signs to flashing hundreds of lamps one at a time. It is built with both single and double-pole switches. The single-pole switch operates by flashing up one word, one letter or one lamp at a time. The double-pole switches are for flashing up whole signs, double-faced signs, whole words or any number of lights at one time.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, MAY 15.—Considerable progress has been made with the erection and equipment of the new power station of the General Post Office which is being built on the banks of the River Thames about one mile from the main post office buildings at St. Martins-le-Grand. When completed the power house will replace two or three small generating stations which are at present located in the basement at St. Martins-le-Grand. At the present time the buildings of the new power house are complete and the erection of the plant is in hand. To meet immediate requirements, two 1,000-kilowatt turbo-alternators and one 500-kilowatt set are being installed, but by the time the supply is available it is anticipated that a further set will be required. The supply will be three-phase at 6,600 volts, with a frequency of 50 periods per second. The boilers will be of the Stirling water-tube type, four being of the land type and three marine. They will each have an evaporative capacity of 17,500 pounds of water per hour.

Tramway matters have been calling for a good deal of Parliamentary attention during the present week. In the first place, a bill has been promoted by the London United Tramways Company, which owns an extensive trolley tramway system that meets that of the London County Council at many points, in which compulsory running powers are asked for over the lines of the County Council.

Interest has also been well sustained in another bill in which the merits of surface-contact systems have been discussed at length. A few years ago the National Electric Construction Company secured powers to construct tramways in Folkestone and two neighboring towns on the condition that a surface-contact system was put down. The company at the time was interested in the Dolter system, but this subsequently proved an utter failure in other places, and it was decided to drop it. The company now asks Parliament to relieve them of the obligation to use any system but the overhead, which really forces them to the expensive conduit system, and to allow them to use the overhead system.

An important conference is to be held between representatives of the London borough councils owning electricity works and London electric-lighting companies, in order to endeavor to put into force a scheme for linking up their undertakings under the terms of the Act of Parliament which was passed last year. This is the first time in the history of London electric supply that a serious effort has been made by the companies and local authorities to work in harmony, and this position has been brought about by the necessity for fighting a common foe during the past three years, viz., the promoters of the big bulk supply schemes. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, MAY 22.—The Marconi Wireless Telegraph Company is under contract with the Dominion government to establish a system of communication in the St. Lawrence River and Gulf, in order that the cities of Montreal, Three Rivers and Quebec may keep in communication with vessels on the river and gulf.

The street-railway company of the city of Brantford, Ont., was threatened with the loss of its franchise because it failed to deposit a bond and begin rebuilding the local system. The company, having failed to meet its obligations of agreement to deposit $25,000 bonds by a guarantee company by March 1, last, and begin rebuilding the local system by May 1, the city threatened to revoke the franchise, which has yet forty-three years to run. The city has now received a couple of subsitute bonds from the company, which will be given another chance to make good, and it will start operations at once.

The equipping of more pay-as-you-enter street cars for the Ottawa Electric Railway, in addition to the large number already in use in this city, is a striking evidence of the advantage of this system of fare collecting. The idea was conceived in Montreal, and in that city the new type of car is very popular. It takes time to educate a traveling public to the new method, so that the gradual process adopted in Ottawa of introducing these cars is found desirable. There are some modifications in the Ottawa cars from those used anywhere else. A report shows that altogether about 3,152 of the regular type of the pay-as-you-enter cars are now in operation on the lines of the different Canadian and American cities. In addition to the many companies already using the new style of car, a number of other companies have secured the necessary license to employ them, and intend to place them in service as soon as they can be secured. As an indication of the good results obtained by the use of this car, a report from one management states that with them the receipts have been increased 22 per cent. The increases per car mile and per car hour have been as high as 50 per cent. There also was a marked decrease in platform accidents, due to the conductor's better control of the entrance and exit. W.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, MAY 22.—The ratepayers of Lethbridge, Alta., have voted in favor of spending $153,000 for the installation of an electrical development plant.

The Boggey Creek Telephone Company has been incorporated at Lumsden, Sask., and the North Carievale Rural Telephone Company at Carievale, Sask. Both concerns will start construction as soon as the necessary supplies have been obtained.

The construction of an electric car line 100 miles in length, tapping both sides of the Okanagan Lake, British Columbia, is to be started shortly. Several branch lines are also planned to be constructed early next year. John F. Langan, Chicago, Ill., is one of the incorporators of the company formed for the purpose.

The Alberta government is considering the installation of automatic telephones throughout that province. For the purpose of seeing the various systems in operation W. H. Cushing, minister of public works, is now visiting a number of American cities.

A report has been prepared on the estimated quantity of available waterpower in Canada and gives the following figures: Quebec, 17,075,039 horsepower; Ontario, 3,129,166 horsepower; British Columbia, 2,000,000 horsepower; Alberta, 1,000,000 horsepower; Northwest Territories, 600,000 horsepower; Manitoba, 505,000 horsepower; Saskatchewan, 500,000 horsepower; New Brunswick, 150,000 horsepower; Nova Scotia, 54,300 horsepower.

The Manitoba Government Telephone Commission is stretching another long-distance wire between Winnipeg and Portage la Prairie, 59 miles.

Willis Chipman, C. E., Toronto, Ont., has been retained to prepare plans and estimates for a municipal electric-lighting plant at North Battleford, Sask.

The municipality of Minota, Man., is advertising debentures, the proceeds of which will be used for constructing a municipal rural telephone system. Reeve Corrand has charge of the matter.

The Street Railway Commission at Port Arthur, Ont., has decided to purchase four pay-as-you-enter cars; J. J. Carrick is the purchasing agent for the commission.

The municipal authorities at Victoria, B. C., are considering the erection of an extension to the civic power plant. R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

BOSTON AND WESTERN ELECTRIC RAILROAD—At the Massachusetts Railroad Commission hearing on the petition of Boston and Western Electric Railroad for certificate for construction from Waltham to Marlborough, F. T. Ley, one of the backers of the road, stated that the estimate of construction is $186,000 larger than in the first petition filed, by reason of the intention to double-track the entire system instead of a single track with turnouts. Except for a short stretch the grade will not be higher than three per cent. He did not believe the road could be built within two years, and if estimate of construction totaled $1,700,000, against a present estimate of $1,500,000, it was quite possible the line would be constructed.

PHILADELPHIA COMPANY—Stockholders of the Philadelphia Company, of Pittsburg, Pa., will meet July 22 to act on the question of increasing the authorized capital of the company from $42,000,000 to $47,000,000. The proposed increase will be in the common stock of the corporation and will be used when issued especially for the exchange of $5,000,000 convertible debentures. It is provided that any such shares not exchanged may be used for the general purposes of the company. A large part of the money secured from the sale of the debentures will be advanced by the Philadelphia Company to the Pittsburg Railways Company and the Allegheny County Light Company for extensions and improvements. Among the improvements provided for by the Railways Company will be the purchase of modern double-truck cars.

PROPOSED FINANCIAL PLAN OF NEW ORLEANS RAILWAYS AND LIGHT COMPANY—It is reported that the directors of the New Orleans Railway and Light Company have decided on a financial plan which involves the creation of $50,000,000

bond issue, of which $5,000,000, it is said, will be purchased at eighty-five by a banking firm of New York city, which recently bought $2,400,000 bonds of the company. It is also reported that the plan provides that the preferred and common shareholders shall part with twenty-five per cent of their stockholdings at forty and fifteen, respectively, and the New York banking firm will be given two members on the board of directors. The proposed $50,000,000 of bonds will bear interest at the rate of five per cent, and $30,000,000 will be held in the treasury against the $30,000,000 four-and-one-half per cent bonds now outstanding.

LIGHTING AND POWER.

(Special Correspondence.)

SIOUX CITY, IA.—The Electric Supply Company has been incorporated with a capital of $10,000.

SPOKANE, WASH.—S. J. Richards has been granted a fifty-year electric-light franchise in this city.

BROKEN BOW, NEB.—J. W. Early, of Columbus, has been granted an electric-light franchise here.

LEWISTON, MONT.—Sam W. Gebo has applied for an electric-light and gas franchise in this city.

LITTLE ROCK, ARK.—This city contemplates a bond issue of $250,000 to build an electric-light plant, etc.

NOWATA, OKLA.—The Nowata Electric Light Company has been chartered here, with a capital stock of $25,000.

AUSTIN, TEX.—The Denison Light and Power Company has increased its capital stock from $125,000 to $200,000.

OAKLAND, CAL.—Articles are now being prepared for the incorporation of an electric-light district in Fruitvale, Cal.

SANGER, CAL.—The Sanger Electric Light Company has filed its application for dissolution in the Superior Court of this county.

WALNUT SPRINGS, TEX.—The Walnut Springs Light and Power Company has been incorporated with a capital stock of $10,000.

CHICO, CAL.—Frank V. Wilson, representing the Sierra Electric Power Company, has been granted an electric franchise in this city.

MINNEAPOLIS, MINN.—A Council committee is working on a franchise for the Northern Heating and Electric Company of St. Paul. C.

NEWPORT BEACH, CAL.—The Newport Bay Electric Light and Power Company has been incorporated with a capital stock of $50,000.

LONG BRANCH, N. J.—The Allenhurst municipal lighting plant has been sold to the Atlantic Coast Electric Light Company for $115,000.

SEATTLE, WASH.—The City Council has passed an ordinance providing for the installation of cluster lights on public highways in this city.

UPLAND, IND.—The town board has granted a franchise to the Hartford City Light and Power Company to install an electric-light plant in this place. S.

GUANAJUATO, MEXICO—The Guanajuato Power and Electric Company proposes to have its electric-light extension to Silao completed within six weeks.

STILLWATER, MINN.—It is proposed to organize a company to take over the Stillwater electric-light plant and the plants furnishing power at Apple River, Wis. C.

PETOSKEY, MICH.—Considerable improvements are being made at the electric-light plant here. New engines are being put in and extensions of the service made.

ELGIN, ILL.—By arrangement with the Aurora, Elgin & Chicago Railway, the city is to be thoroughly lighted and all the old arcs replaced with lamps of new design.

EUGENE, ORE.—The McKenzie Valley Irrigation and Power Company has secured a franchise for operating an electric-light and power system in Springfield and this city.

ALBANY, N. Y.—The electric-light service is to be extended by the Municipal Gas Company of Albany to the suburb of Slingerlands and four or five adjacent villages.

CHICAGO, ILL.—The Interstate Light and Power Company, a New Jersey corporation, has been incorporated to operate light, heat and power plants, with a capital of $750,000.

BAKER CITY, ORE.—The Eastern Oregon Light and Power Company has been incorporated here with a capital stock of $1,500,000 by Ray Hye, F. A. Harnon and John Rand.

ALAMEDA, CAL.—An Electric Light Commission has been formed in this city, with Wynn Meredith as chairman, to urge the construction of a municipal electric-light plant, for which bonds were issued some time ago.

LAFAYETTE, IND.—The annual convention of the Indiana Municipal League will be held in this city June 22, 23 and 24. The principal topic for discussion is that of municipal lighting, and the advocates of municipal ownership and anti-municipal ownership are preparing statistics and other data for an animated debate. S.

SALT LAKE CITY, UTAH—The Borkman Electric Company has been incorporated here, with a capital stock of $25,000, by G. Borkman, president, P. C. Dykes and J. H. Parkes.

MISHAWAKA, IND.—The Business Men's Association has decided on a complete electric-lighting system for this town. The style of the lights and poles is still to be decided on.

BALTIMORE, MD.—The city of Baltimore has a municipal lighting project in view. Plans have been drawn up and the expert sets the probable cost of a suitable plant at $1,350,000.

LOS ANGELES, CAL.—The Newport Bay Electric Light and Power Company has been incorporated here, with a capital stock of $50,000, by W. H. Paden, C. H. Ghrist and W. W. Crosier.

CAMDEN, N. J.—The Phœnix Water Power Company, of Camden, has been incorporated, with a capital of $150,000, by F. R. Hansell, G. H. B. Martin and J. A. MacPeak, Camden.

MODESTO, CAL.—W. H. Hatton and Archie Scott, of the La Grange Light and Power Company, have made arrangements for the purchase of land near this city for the erection of power houses.

LOS ANGELES, CAL.—The Westside Electric Company has been incorporated here, with a capital stock of $75,000, by C. W. Anderson, R. C. Shippee, J. F. Stratton, Jacob Feiber and F. V. Gordon.

SANTA ROSA, CAL.—The Snow Mountain Water & Power Company has asked for the right to construct 17.58 miles of electric power line from its Fulton line to Gurneyville, at a cost of $300 per mile.

LOS ANGELES, CAL.—The Surf Light and Power Company has been incorporated here, with a capital stock of $1,000,000, by C. W. Hicks, Chas. Kraft, J. L. Haley, J. L. Kroeger, J. H. Maurice and others.

SAN FRANCISCO, CAL.—The Great Western Power Company recently secured the contract for supplying electric power to the Southern Pacific Company for the operation of its interurban railway system.

HURON, S. D.—C. I. Bowe has sold the Huron Electric Company's plant to Coler Campbell, who has been granted a twenty years' franchise by the city. The plant thus passes to the control of the Huron Gas Company. C.

DOWNIEVILLE, CAL.—Walter Painter and Homer Gould have located 15,000 inches of water from the North Yuba River just below this city, to be used in developing electric power for mining and lighting purposes.

OAKLAND, CAL.—The Central Oakland Light and Power Company applied recently for permission to increase its bonded indebtedness by $800,000. The company proposes to extend its systems and acquire additional facilities.

DECATUR, GA.—The Town Council has passed an ordinance exempting the Decatur Electric Light Company from taxation for the year 1909, this step being taken in accordance with the terms of the franchise granted some years ago. L.

GREENFIELD, MASS.—The Orange electric-lighting and power plant is to be extensively improved this year, work to begin in a few weeks. The principal improvements are a new dam and power house at Wendell Depot.

SPRING HILL, DEL.—The Spring Hill Light and Water Company has been incorporated at Wilmington; capital, $100,000. Incorporators: Ernest B. McNair and Edward G. Cook, Brandywine Head, Del.; David J. Reinhardt, Wilmington.

MINNEAPOLIS, MINN.—The Minneapolis General Electrical Company has ordered two 1,000-kilowatt rotary converters, at a cost of $76,000. The company has closed a contract with the Chamber of Commerce to supply it with light and power for a term of years. C.

TORONTO, CAN.—Contracts have been awarded by the Hydro-Electric Power Commission for the copper wire for the protective system to the Dominion Wire Manufacturing Company of Montreal, and for the porcelain insulators to the Ohio Brass Manufacturing Company, of Mansfield, Ohio. The estimated cost of the system is $106,000.

SEATTLE, WASH.—The superintendent of the Seattle Water and Light Department has submitted a report to the lighting committee of the City Council, showing how he expects to expend the available $535,000 in extending the municipal lighting system. This amount will be available only after the bonds have been sold and the water and general funds are reimbursed for loans. With these amounts paid, $235,000 will be available for immediate extensions. There are at present 626 arc street lights

and 3,019 incandescent street lights, and it is proposed to add 117 more arcs and 1,595 incandescents in addition to the extensions for commercial purposes.

AIKEN, S. C.—John A. Seigler and R. B. Carter, of Aiken; W. D. McNeal, of Fayetteville, N. C., and others are organizing a company to build a 10,000-spindle yarn mill; brick buildings; will develop 250 horsepower from waterpower and 250 horsepower by steam.

WARE, MASS.—The George H. Gilbert Manufacturing Company, maker of woolens, is making preparations for building a large electric power plant at No. 4 mill, from which power will be supplied to run Nos. 1 and 2 mills by electricity, instead of steam, as at present.

DES MOINES, IOWA—The Des Moines Electric Company has taken bids for the erection of a new plant, to cost $200,000. The building will be two stories, 135x62 feet, with a smokestack 200 feet high and sixteen feet in diameter. Contracts have been let for a steam turbine and boilers of 2,600 horsepower. C.

ST. LOUIS, MO.—H. Phillips, receiver for the public utilities in Nevada, Mo., sold at public auction, May 15, the light, water, power and electric railway plants and all appliances to A. Mitchell, of St. Louis, for $61,200. The property was sold under foreclosure of $161,200 first mortgage bonds held by the Lincoln Trust Company, of St. Louis.

CRESCENT CITY, CAL.—The Smith River Electric Company has been incorporated here by Charles M. Lindsey, president; D. C. Bemarrest, vice-president; A. V. Massy, Carl Senn, E. C. Swartz, E. C. Hegler and Samuel Harris. The corporation proposes to build two power plants on the Smith River, where electric power will be generated to supply Humboldt County, California, and portions of Josephine County, Oregon.

BAKER CITY, ORE.—The Eastern Oregon Light and Power Company has been incorporated here with a capital stock of $1,500,000, by F. A. Hermon, Ray Nye and J. L. Rand. The new company is the outcome of the consolidation of the Fremont Power Company and the Baker Light and Power Company. The Olive Lake power plant and the Rock Creek plant, which now supply several thousand horsepower, are to be enlarged.

HAZLETON, PA.—Calvin Pardee, of Philadelphia, and other capitalists associated with him in the Harwood Power Company that is erecting a mammoth power plant at Harwood, near here, have given public notice of their intention to form companies in Black Creek, Foster, Sugarloaf, Nescopeck and Butler townships, all within a radius of twelve miles of Hazleton, for electric lighting and the furnishing of current. These companies will get their power from the Harwood plant.

OAKLAND, CAL.—The new power plant of the Southern Pacific Company at Fruitvale, Cal., is now under construction. The building will be three stories high, with a ground area of 128x228 feet. The structure will be of reinforced concrete to the second story, and brick for the balance of the building. The roof will be of tiling placed directly upon the steel rafters. The floors and wainscoting will be of vitrified tile. The building will be completed within the next ninety days.

LAS VEGAS, N. M.—To transmit waterpower over a high-tension transmission line from twenty miles north of Santa Fe is the project of E. H. Fisher of Cimarron and associates, whose application for rights to the use of thirty feet of the Namba River has been granted by Territorial Engineer Vernon L. Sullivan. The plan is to erect a power plant on this stream, costing a quarter of a million dollars, which is to develop 3,000 horsepower and send it in the form of electric power to Santa Fe, Albuquerque, Espanola and Las Vegas.

STEPHENSON, MICH.—Within a few months it will be possible to turn the wheels of every factory in Menominee and Marinette by the harnessed power of the Menominee River, conveyed over cables from the power plant which the Menominee & Marinette Light and Traction Company is building at the Grand rapids, twenty miles from the mouth of the stream. The plant will cost not far from a million dollars to install. There is a fall of twenty-eight feet within a distance of two miles in that portion of the river that is being developed, which means a normal of 6,000 horsepower and a "peak" of 7,000.

SALISBURY, N. C.—Announcement has been made here that a movement will be inaugurated during June looking to the reorganization of the Whitney Reduction Company, which about a year ago was placed in the hands of a receiver, Col. John S. Henderson, the company at that time being engaged in developing extensive waterpower on the Yadkin River about twenty miles from Salisbury, the capitalization being about ten million dollars. The promoters are awaiting a decision from Federal Judge J. C. Pritchard in the case of a $250,000 claim filed against the company by the T. A. Gillespie Company, contractors, who put in the said claim for construction work done on the plant, as alleged in the formal complaint in the case a year ago. The development of the waterpower controlled by the company promises to be one of the largest in this section of the country. L.

ELECTRIC RAILWAYS.

(Special Correspondence.)

GARY, IND.—The Gary and Interurban Electric Railway has started work on the line between Gary and Hammond, Ind.

MONTEREY, CAL.—H. R. O'Bryan has been granted an electric railway franchise on certain thoroughfares in this city.

GARDNERVILLE, NEV.—A. Jensen and H. H. Springmeyer have applied for an electric street-railway franchise in this place.

SAN DIEGO, CAL.—E. W. Peterson has applied for an electric-railway franchise along certain public highways in San Diego County.

VACAVILLE, CAL.—President T. C. Gregory, of the Vallejo & Northern Electric Company, has applied for an electric-railway franchise in this place.

PEORIA, ILL.—Franchises for the entry of interurban electric lines and electrically operated freight traffic along Washington Street have been granted.

MEXICO, MO.—The Mexico, Santa Fe and Perry Traction Company has obtained a franchise for its electric line connecting Hannibal, Mexico, Fulton and Columbia.

CENTRALIA, WASH.—The Twin City Light and Traction Company has been granted a franchise to operate electric railways along certain public highways in Lewis County.

SAN RAFAEL, CAL.—A corps of surveyors and engineers has been working in Marin County for the past week making surveys for a new electric line from Sausalito to San Rafael and Petaluma.

GRAND RAPIDS, WIS.—The franchise of the electric railway to be constructed between this city and Nekoosa this summer has been granted, and in addition it was given the right to furnish power in the city.

LYNCHBURG, VA.—The chartering of the Peoples Improvement Company, of this city, of which R. J. Hughes is president, is announced. The company proposes to build a street railway, capital $25,000; location, Lynchburg. L.

COLUMBUS, IND.—The Indianapolis, Columbus & Southern Traction Company is negotiating with two or three "old-line express companies" relative to the establishment of an interurban express service between Indianapolis and Louisville.

SAN FRANCISCO, CAL.—The proposed bond election for deciding on the issuance of $1,950,000 for the reconstruction of the Geary street road, will be held in this city on June 24, 1909. An underground electric conduit system will be installed.

PORTLAND, ORE.—The Portland Railway, Light and Power Company has issued an order that all motors used in the business section of the city are to be supplied by direct-current electricity, as soon as the new substation is in running order.

EAU CLAIRE, WIS.—Work is under way for the survey of lines between Eau Claire and Altoona for the projected interurban railway of the Chippewa Valley Railway, Light and Power Company, which it is contemplating constructing the present season.

WHITEHALL, N. Y.—The electric line from Fair Haven to Poultney, Middletown, Granville, Well and Pawlet is to be built. A $1,000,000 corporation has been formed. The source of the necessary electric power will probably be at Poultney, using the Mettowee River.

PIERRE, S. D.—Articles of incorporation have been filed here for the South Dakota Interurban Railway Company, with headquarters at Centerville, and a capital of $1,000,000. It is proposed to construct 160 miles of road from Sioux City, Ia., to Bijou Hills, S. D.

CANTON, OHIO—Immediate steps are being taken to begin work on the Cleveland, Alliance and Mahoning Valley railroad, the interurban line which is to connect with the Stark Electric at Alliance. Several small steam-railway branches have been acquired and will be electrified.

MILWAUKEE, WIS.—A meeting of the Milwaukee Western Electric Railway Company will be held in June for the election of directors. The line as projected will run from Beaver Dam to Milwaukee. It is capitalized at $200,000, but the promoters now say the capital stock will be increased to $1,500,000.

NEW YORK, N. Y.—The New York & North Shore Traction Company has applied to the Public Service Commission for the approval of franchises granted by the Board of Estimate and Apportionment covering the extension westward of two lines to Whitestone and Flushing. A hearing has been set for May 25.

SAN FRANCISCO, CAL.—At a meeting of the stockholders of the United Railways and the United Investment Company this week, it was decided to reorganize the Stanislaus Electric Power Company, which was recently purchased at auction for $2,200,000. This plant, which can furnish 45,000 horsepower, will hereafter be known as the San Francisco Electric Railways Company, with

a capital stock of $10,000,000. The United Railways Company proposes to make a number of suburban extensions in the near future. General Manager Black, of the United Railroads, has announced that the company now has in operation 12 of the 25 new cars, which were ordered some time ago. A.

RENO, NEV.—The annual meeting of the Nevada Interurban Railroad Company, headquarters in this city, has just been held, and a decision reached to proceed at once with the building of a large park on the Interurban Heights ground here. Louis Burrem will probably be re-elected president of the road by the new directors.

FAIRFIELD, CAL.—A franchise has been granted to the Trowbridge & Wright Company of Oakland to construct and maintain an electric railroad connecting Vallejo, Benicia and White Sulphur Springs. This company has purchased the White Sulphur Springs property and will improve it for an attractive summer resort.

VINCENNES, IND.—M. Yelton, who is at the head of the company which proposes to build an interurban line from Vincennes to Jasper, announces that a St. Louis trust company had agreed to take $500,000 worth of bonds as soon as the company disposed of $250,000 worth of stock and that work on the road would begin in sixty days.

EVANSVILLE, IND.—A demand on the part of the union employes of the Evansville Street Railway Company for a substantial increase in wages and other concessions is about to precipitate a strike, the company having declined to consider the demand. A former strike on this line a few years ago was destructive of life and property. S.

ROCKDALE, TEX.—The Rockdale-Florence Interurban Railroad, on which work is to be started right away, will connect Rockdale and Florence, via Granger or Bartlett, according to the feasibility of the routes. It will traverse the richest portion of Texas, and will open up a section of the state that is without transportation facilities.

BLUEFIELD, W. VA.—An electric railway is to be built from Ronceverte to Rich Creek. In case this plan materializes the Virginian and Chesapeake & Ohio railways will be connected and a large and prosperous farming community given transportation facilities. The route proposed will put this road through Peterstown, Sweet Springs and Union.

NORTH MANCHESTER, IND.—The Town Board has granted a franchise to the Wabash & Northern Traction Company, which proposes to build a traction line between Wabash and Warsaw. This grant completes the right-of-way and terminals for the entire distance, and work is to be begun at once. J. A. Barry, of Wabash, is at the head of the company. S.

SPRINGFIELD, OHIO—The Columbus, Plain City and Urbana Electric Railway Company has been incorporated with a capital stock of $10,000. It proposes to build a line from Columbus through Plain City, Mechanicsburg and Urbana. There are no electric lines in this territory and the promoters expect to make the new road a good paying investment.

RUTLAND, VT.—Negotiations are now under way to have the Rutland Railway, Light and Power Company take over the passenger traffic of the Delaware & Hudson Company in this state and electrify the lines from Castleton to Eagle Bridge, N. Y., and from Fair Haven to Whitehall, N. Y., operating them in connection with the present local trolley system.

WAUKESHA, WIS.—The Milwaukee-Western Electric Railway Company is seeking a franchise to enter this city. The company has a survey of its proposed line completed from Beaver Dam to Pewaukee. The proposed new line would connect Waukesha with Lannon, Sussex and Menomonee Falls, places with which this city now has no direct connection by rail.

LEXINGTON, KY.—At a meeting of the board of directors of the Lexington and Interurban Railway Company, held in Philadelphia, plans for extensions were considered and determined on. The Nicholasville, Richmond and Winchester lines are yet to be completed. Then it will probably extend to Danville, Harrodsburg and Lawrenceburg, from Versailles or Frankfort.

SACRAMENTO, CAL.—It is reported that the Northern Electric Company has succeeded in floating bonds to the amount of $10,000,000 in Amsterdam. The money is to be used in a merger with the Vallejo & Northern Railway Company, in constructing a new line which will connect the lines now operated by the two companies, thus securing ferry connections to the interior.

ST. LOUIS, MO.—The Southwestern Ohio Traction Company has been organized in Ohio to operate about 400 miles of electric lines. The plans provide for merging a number of existing electric lines and building an entrance into Cincinnati to connect with a number of lines reaching many of the important towns in the southern part of Ohio. New lines and branches are projected. Application has been made to the City Council of Cincinnati for a franchise to build an underground, elevated and surface line from the center of the city to Norwood, six miles, with branch lines. This line is to have a grade not to exceed one per cent, and no grade crossings. Work is to be begun this summer. G. H. Worthington is chairman, Cleveland, Ohio; John E. Bleekman president, W. L. Moyer, S. M. Jarvis, C. Hansel and J. L. Greatsinger, all of New York, are directors. Charles Hansel & Co., 43 Exchange Place, New York, are the engineers in charge.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has started the schedule for the increased service on the elevated lines, as ordered by the Public Service Commission. The orders arrange for the maximum service during the rush hours, and a graduated service during the other hours of the day.

FT. WAYNE, IND.—The next bi-monthly meeting of the Central Electric Railway Association will be held in the Anthony Hotel, this city, June 3. Papers will be read by J. A. Gohen, of Indianapolis, on the "Practicability of Piece Work," and by W. B. Wright, of Rushville. "New Devices and New Experiences" is the subject proposed by A. A. Anderson, president of the association. S.

ROCKFORD, ILL.—The Rockford & Interurban Railway Company has been sold to an eastern syndicate. Included in the deal, which is said to involve over $1,000,000, are the city lines and the Beloit, Freeport and Belvidere interurban systems. The property changes hands July 1, next. It is possible the new company will build south from Rockford to Byron, Oregon and Dixon. F.

SEATTLE, WASH.—President Col. Albert M. Dewey, of the Okanogan Electric Railway Company, announces that the recent $3,000,000 bond issue has been purchased by French capital. A line 75 miles in length will be built soon from Nighthawk, Wash., to a point on the Columbia River, where navigation can be secured. The plans also call for extensions both east and west to Spokane and this city, making more than 500 miles in the entire system.

HARTFORD, CONN.—The state legislature has extended the charter of the East Hartford & Windsorville Street Railway Company to November 1, 1910, and an arrangement has been completed between this concern, which has not yet built any of its line, and the Hartford & Springfield Street Railway Company, by which the latter is to build south from Broad Brook to Windsorville Green and the first-named company will build north from East Hartford to meet it at Windsorville.

LOS ANGELES, CAL.—The Pasadena Rapid Transit Company has announced plans for a high-speed electric railway between Pasadena and this city. The new road will be operated by the third-rail protected system. Steel coaches, having three doors on each side, will be used. It is stated that the cars will have a loading and unloading capacity of 200 people in twenty seconds. A subway is planned into the heart of the city, making the route between the two cities most direct.

PORTLAND, ORE.—The Inland Oregon Electric Railroad Company has been incorporated with a capitalization of $1,000,000. The incorporators are Mark W. Gill, H. J. Martin and C. D. Charles. The corporation proposes to construct an electric line from Condon to Canyon City, passing through Fossil. A spur is to be built from Fossil to the confluence of Trout Creek with the Deschutes River. The line will also run from Cross Keyes to Bend, through O'Neil, and also from O'Neil through Prineville to Howard.

ROCK ISLAND, ILL.—An interurban line between Galesburg and Rock Island is to be built. The promoting company is incorporated under the laws of the state of Illinois as the Galesburg and Rock Island Traction Company. The completion of the road is expected to bring about direct interurban connection between the cities of Rock Island and Peoria, Ill., the connection being by the Galesburg and Rock Island Traction Company lines to Galesburg and by the Southern Interurban lines between Galesburg and Peoria. The estimated cost is $2,000,000.

NEW YORK, N. Y.—Under alterations in route for which the Public Service Commission has given its permission to the New York City Interborough Company, a line of surface cars will shortly be operated from the newly opened Two Hundred and Thirty-eighth Street station of the subway on the Broadway-Van Cortlandt line, to the terminus of the branch of the subway which runs to Bronx Park. At present the New York City Interborough cars leave One Hundred and Eighty-first Street, where there is a subway station, and get into the Bronx across Washington Bridge. After May 29 that line will run no further eastward than Kingsbridge Road and Aqueduct Avenue.

ST. LOUIS, MO.—The United Railways Company has obtained a fifty years' extension franchise of its county properties. It owns and operates the county lines as the Missouri Railroad Company. The Secretary of State at Jefferson City extended the charter of the Missouri Railway Company for a period of fifty years from April 28, 1909. This was in accordance with a resolution passed by more than two-thirds of the stockholders at a meeting held in St. Louis last Wednesday, accepting the general provisions of the corporation laws of the state and voting an extension of charter. The company has a capital stock of $2,400,000. Robert McCulloch is president and James Adkins, secretary.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

NEW AUBURN, WIS.—Citizens have incorporated a local telephone company. C.

EDGEWOOD, IOWA—The Interstate Telephone Company will rebuild its entire system here. C.

WAUKON, IOWA—The local exchange of the Standard Telephone Company will be rebuilt. C.

LEAGUE CITY, TEX.—A telephone system will be installed here by J. E. Walker and others.

OSKALOOSA, IOWA—The Home Telephone Company will install about five miles of new cable. C.

NIXON, TEX.—The Nixon Telephone Company has been incorporated with a capital stock of $6,200.

MALMO, NEB.—The Citizens' Telephone Company has been incorporated with a capital stock of $3,000.

DORSEY, NEB.—The Dorsey Telephone Company has been incorporated with a capital stock of $3,000.

TESCA, OKLA.—The Tesca Telephone Company has been incorporated with a capital stock of $1,000.

FARNHAMVILLE, IA.—The Farnhamville Mutual Telephone Company will construct a toll line to Paton.

FORT COBB, OKLA.—The Southside Telephone Company has been incorporated by S. I. Ratcliffe and others.

HORICON, WIS.—The Horicon Telephone Company has been incorporated with a capital stock of $10,000.

RIVERVIEW, WIS.—The Riverview Telephone Company has been incorporated with a capital stock of $20,000.

CEDAR, OKLA.—The Orchard Center Telephone Company has been organized by Wm. H. Thorn and others.

LODGE POLE, NEB.—The Lodge Pole Telephone Company has been incorporated with a capital stock of $10,000.

FAYETTE, IOWA—The Northern Iowa Telephone Company has commenced the construction of a $3,300 building. C.

WASTA, S. D.—The Elm Springs-Wasta Telephone Company has been incorporated with a capital stock of $10,000.

GREEN BAY, WIS.—The Fox River Valley Telephone Company is extending its lines to Morrison and Pine Grove.

GORDON, NEB.—The People's Telephone Exchange Association has been incorporated with a capital stock of $4,000.

ST. LOUIS, MO.—The Missouri Electric Storage Battery Company has been incorporated with a capital stock of $25,000.

WHITEHORSE, OKLA.—The Whitehorse Rural Telephone Company has been organized by W. C. Douglas and others.

MARMADUKE, ARK.—The Independent Rural Telephone Company has been incorporated with a capital stock of $2,000.

SNYDER, OKLA.—The Scurry County Telephone Company has been organized by R. N. Miller, Geo. T. Curtis and others.

ARAPAHOE, OKLA.—The Deer Creek Mutual Telephone Company has been given a franchise to install an exchange here.

PLEASANT PLAIN, IOWA—The Pleasant Plain Telephone Company will improve its lines and build others this spring. C.

CULBERTSON, MONT.—The Montana Star Telephone Company has commenced construction of an exchange building. C.

FARNHAMVILLE, IOWA—The Farnhamville Mutual Telephone Company has made arrangements to install a new toll line to Paton. C.

MARYSVILLE, CAL.—It is understood that the Pacific Telephone Company has purchased property in this city and will erect an office building.

RED BLUFF, CAL.—The United States Forest Service is building a telephone line from Paskenta to Poison Glade, a distance of twenty miles.

INDIANOLA, IOWA—The Mutual Telephone Company will restore the old rates and maintain them for seven years and will expend $12,000 in improving the plant. C.

MAQUOKETA, IOWA—The Bell Telephone Company is considering the expenditure of $25,000 to $30,000 this summer in improvements and rebuilding its system. C.

LEXINGTON, TENN.—The Home Exchange Company is the style of a firm organized in this county to give complete telephone connection with exchanges at Sardis, Saltillo, Henderson, Scott's Hill, Decaturville and Lexington. The central office will be located here. The promoters of the enterprise are: Dr. J. C. Stinson of Center Point, and E. L. Fesmire and J. F. Hawthorne of this place.

MILFORD, IOWA—The Midland Telephone Company will increase its capital stock to $50,000 and either buy the exchange at Spirit Lake or install another one. C.

SAN JOSE, CAL.—The Pacific States Telephone and Telegraph Company has received preliminary drawings for the erection of a $50,000 telephone building in this city.

POCATELLO, IDAHO—The Idaho Independent Telephone Company has been incorporated here by D. W. Standrod, H. R. Risley, T. S. Lane, Frank Frost and Irving Whitehouse.

COUNCIL BLUFFS, IOWA—A mortgage and trust deed to secure $500,000 bonds from the Independent Nebraska-Iowa Long-Distance Telephone Company to the Day and Hess Co. has been filed. C.

SAN FRANCISCO, CAL.—The Postal Telegraph and Cable Company has let contracts for a $3,640 one-story concrete cable station at East Twenty-seventh Avenue and Fulton Street in this city.

CECIL, WIS.—The Cecil-Green Valley Toll Line Company has been organized with J. S. Bremich, president, Anton Berg, vice-president, J. H. Kuehl, secretary and treasurer, and Herman Borcher, manager.

COLUMBUS, OHIO—The Port Williams Mutual Telephone Company, of Port Williams, has been incorporated here: J. D. Vandervort, Albert Ellison, S. S. Earley, John Stephens, A. C. Kline; capital, $10,000.

NASHVILLE, TENN.—The Brown Pile Telephone Company of Wilson County has been incorporated, with Messrs. Doak Thompson, C. C. Arnold, C. H. McClain, R. R. Harkread and W. J. Eagan, incorporators.

SAN FRANCISCO, CAL.—The Western Union, the Postal Telegraph and the Pacific States Telephone companies have been taxed a rental of $10 a month for the right to land their cables on the San Francisco water front.

MILWAUKEE, WIS.—Wireless telephone messages from Chicago have been received at the office of the Milwaukee Journal. According to the Journal the messages came as clearly and distinctly as through an ordinary telephone.

SONORA, CAL.—The Pacific Telephone and Telegraph Company is building new toll lines between Stockton and this city, which will cost in the neighborhood of $45,000. New lines are also planned in Tuolumne County and elsewhere.

LLANO, TEX.—Representatives of the Southwestern Telephone Company have been in Llano lately, and it is said that the company will become interested in Llano in the near future. Llano has two independent telephone and telegraph companies now.

OTTAWA, ILL.—The plants of the two telephone companies have now passed under one control and the Ottawa Banking and Trust Company has been made trustee for the trust deed given by the United Telephone Company. New officers have been elected.

EL PASO, TEX.—Work of extending the Southwestern Telephone Company's lines into East El Paso, between the Southwestern shops and Highland Park, has been started. This will add almost a hundred telephones to the local exchange, which already has over 4,000 connections.

BOSTON, MASS.—Governor Draper has signed resolve providing for a continuation of the inventory and appraisal of the property of the New England Telephone Company authorized by the Legislature of 1907. The present resolve carries an additional appropriation of $35,000.

EAU CLAIRE, WIS.—John H. Perkins, Frank Knight and D. W. Showdy, Eau Claire capitalists, have filed articles of incorporation with the Secretary of State for a new telephone company, to be known as the Riverview Telephone Company, with headquarters at Riverview, Eau Claire County.

PRESCOTT, ARIZ.—The Arizona Overland Telephone Company has purchased the local franchise of Robert Brow, M. J. Hickey and H. T. Andrews, for a telephone and electric system. The company will make this place its headquarters for a long-distance system in Arizona, New Mexico and California.

PITTSFIELD, MASS.—The annual report of the New England Telephone and Telegraph Company just issued shows that this city has the largest exchange in the Pittsfield district, which extends from Great Barrington to Bennington, Vt. The number of subscribers for the exchanges in Berkshire County is as follows: Pittsfield, 2,836; North Adams, 1,105; Adams, 330; Becket, 80; Dalton, 222; Great Barrington, 575; Hinsdale, 74; Housatonic, 43; Lenox, 202; Lee, 288; Stockbridge, 127. Among the new exchange switchboards installed during 1908 is one at Dalton.

ELECTRICAL SECURITIES.

There was a quieting down of speculative animation last week. Not only were dealings less active, but they were largely professional and with irregular price changes. The undertone, however, held steady, and with quite a few good net gains. The most conspicuous price movements were the making of a high record for United States Steel common and Southern Pacific. Reading also advanced close to its high record of 1906.

Dividends have been declared upon the following electrical securities: Indianapolis Street Railway Company; a dividend of three per cent on the common stock, payable July 1 to stock of record June 20. Norfolk Railway and Light Company; the regular semi-annual dividend of two per cent, payable June 5 to stock of record May 22. General Electric Company; the regular quarterly dividend of $2 per share, payable July 15 to stock of record June 3. Rochester Railway and Light Company; the regular quarterly dividend of one-and-one-fourth per cent on the preferred stock, payable June 1 to stock of record May 24.

ELECTRICAL SECURITIES FOR THE WEEK ENDED MAY 22.

New York:	*Closing.*
Allis-Chalmers common	16⅛
Allis-Chalmers preferred	51⅛
American Tel. and Tel. Company	139
Brooklyn Rapid Transit	78¾
General Electric	160
Interborough-Metropolitan common	16⅛
Interborough-Metropolitan preferred	45
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	78
Mackay Companies (Postal Telegraph and Cables) preferred	73½
Manhattan Elevated	146
Metropolitan Street Railway	25
New York & New Jersey Telephone	114
Western Union	76¼
Westinghouse Manufacturing Company	83½

The directors of the Interborough Rapid Transit Company have re-elected the retiring officers.

The business of the General Electric Company shows steady improvement. Orders are coming in at slightly better than at the rate of $53,000,000 per annum, compared with orders booked during the fiscal year ended January 31 of $42,186,917, an improvement of twenty-six per cent and over eighty-five per cent ahead of the low point of the depression. The betterment in operating conditions is reflected at the Lynn works, where the company is now employing 8,000 men, against 5,000 at the low point and 10,000 during the 1907 boom. The Lynn weekly payroll now exceeds $105,000, against $60,000 at the depth of the depression and about $130,000 at the high point of 1907.

Boston:	*Closing.*
Edison Electric Illuminating	—
Massachusetts Electric	70
New England Telephone	132
Western Telephone and Telegraph pref.	87
Philadelphia:	*Closing.*
Electric Company of America	12½
Electric Storage Battery common	47½
Electric Storage Battery preferred	47½
Philadelphia Electric	12⅜
Philadelphia Rapid Transit	33½
United Gas Improvement	88
Chicago:	*Closing.*
Chicago Telephone	133
Commonwealth Edison	118
Metropolitan Elevated preferred	51
National Carbon common	86
National Carbon preferred	118

The Boston Stock Exchange has placed on the regular list 55,000 shares of common and 45,000 shares of preferred stock of the National Carbon Company.

Commonwealth Edison earnings are increasing so satisfactorily that there is talk of an increase in the dividend rate from six to seven per cent. No change is likely to be made in the near future, officials say.

NEW PROPOSALS.

POST OFFICE AND COURT HOUSE, MOSCOW, IDAHO—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 p. m., June 30, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. post office and court house at Moscow, Idaho, in accordance with drawings and specification, copies of which may be had at the Supervising Architect's office or from the custodian of site at Moscow, Idaho.

POST OFFICE AND CUSTOM HOUSE, GULFPORT, MISS.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 p. m., June 21, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office and Custom House at Gulfport, Miss., in accordance with drawings and specification, copies of which may be had from the custodian of site at Gulfport, Miss., or at the Supervising Architect's office.

POST OFFICE BUILDING AT CLIFTON FORGE, VA.—The office of the Supervising Architect, Treasury Department, Washington, D. C., will receive sealed proposals until 3 o'clock p. m., on the 9th day of June, 1909, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Clifton Forge, Va., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Clifton Forge, Va., or at the office of the Supervising Architect.

POST OFFICE AND COURT HOUSE, LONDON, KY.—The office of the Supervising Architect, treasury department, Washington, D. C., will receive sealed proposals until 3 p. m., June 16, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system) of the U. S. Post Office and Court House, at London, Ky., in accordance with the drawings and specification, copies of which may be had from the custodian of site at London, Ky., or at the office of the Supervising Architect.

ELECTRIC-LIGHTING SYSTEM, FORT TOTTEN, N. Y.—The office of the Constructing Quartermaster will receive sealed proposals in triplicate for the construction of an electric-lighting system at Fort Totten, N. Y., until 2 p. m., June 15, 1909. Plans, specifications, and information furnished by the Constructing Quartermaster's office upon request. Plans and specifications may be seen at office of the Chief Quartermaster, Governors Island, N. Y. Envelopes containing proposals to be marked "Proposal for Electric Lighting System," and addressed "Constructing Quartermaster, Fort Totten, N. Y."

ELECTRIC-LIGHTING SYSTEM, FORT HAMILTON, N. Y.—The office of the Constructing Quartermaster will receive sealed proposals in triplicate until 1 o'clock a. m., June 15, 1909, for material and labor required in the construction of an electric-lighting system and substation at this post. Plans and specifications can be seen at the office of the Chief Quartermaster, Department of the East, Governors Island, N. Y., or at the Constructing Quartermaster's office. Envelopes containing proposals must be marked "Proposals for Electric Lighting System at Fort Hamilton, N. Y," and addressed to the Constructing Quartermaster, Fort Hamilton, N. Y.

EDUCATIONAL NOTES.

HEBREW TECHNICAL INSTITUTE—The Hebrew Technical Institute, New York city, has published its 1909 catalogue, which contains a history and description of the institution, the conditions for admission, general regulations, courses of instruction, list of graduates, etc. This institute is intended primarily for the technical education of Israelites so as to fit them for success in the mechanical trades, and partakes of the nature of a trade school, a manual-training school, and a polytechnic institute. There are both day and evening courses.

SUMMER SCHOOL FOR ARTISANS OF THE UNIVERSITY OF WISCONSIN—The ninth session begins June 28, continuing for six weeks. Courses are offered in steam and gas engines, electricity, machine design, mechanical drawing and allied subjects. There are no entrance requirements. Advanced engineering courses are offered for those having the requisite preparation. A new feature of the coming session will be courses in public utilities testing and accounting, for those desiring to become familiar with the requirements of the Railroad Commission of Wisconsin which has the administration of the Wisconsin public utilities law. Information may be obtained from F. E. Turneaure, Dean, College of Engineering, University of Wisconsin, Madison, Wis.

ENGINEERING SOCIETIES.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY ELECTRICAL ENGINEERING SOCIETY—This society gave a farewell dinner on May 6 to Prof. H. E. Clifford, who has resigned as head of the electrical department at the Institute of Technology to accept the position of professor of electrical engineering at the Harvard Graduate School of Applied Science. In his farewell speech at the dinner, Professor Clifford said that he felt extremely sorry that he should have to be present at a farewell dinner given in his own honor. The only reason for the change, he said, was that he felt that it was for the good of technical education. It was not a question of his cheering for Harvard, but of his advancing the new graduate school of science. There is, and probably never will be any real rivalry between the Harvard school and the Institute, for the two schools are widely different, the Harvard school being a strictly graduate school.

FRANKLIN INSTITUTE—Prof. E. E. F. Creighton, of Union University, and consulting engineer of the General Electric Company, Schenectady, N. Y., delivered a lecture on "Lightning Phenomena," with experimental demonstrations, at the Franklin Institute, Philadelphia, on May 11, at 8 p. m.

OBITUARY.

WILLIAM SPENNER, who telegraphed the enabling act and the Constitution of Nevada to Washington to enable ratification to be made in time to permit Nevada to vote for Lincoln's re-election, died at his home in Reno, Nev., on May 19.

HENRY H. ROGERS, vice-president of the Standard Oil Company, and connected with a number of electric-light and railway companies, died on May 19 at his home in New York city as the result of a stroke of apoplexy. Funeral services were held on May 21 at the Unitarian Church of the Messiah, New York city, and the interment was at Fairhaven, Mass.

CHARLES TURNER HUGHES died of pneumonia at his home in East Orange, N. J., on May 4. Mr. Hughes started as a railroad man with the New York Central. Edison secured him in 1870 in connection with a scheme to apply electricity to the running of surface cars. Hughes devoted all his time to the subject, and Mr. Edison is authority for the statement that but for Hughes the modern trolley might not yet have been developed. Mr. Hughes was a native of New York state, but went to East Orange to live about twenty years ago. Eight years ago he had a stroke of paralysis and retired from active business. His widow and a brother survive him.

CLARENCE IRVING ZIMMERMAN met an untimely death as the result of an accident while canoeing on Lake Mendota at Madison, Wis., last week. He was in the water for over half an hour before help arrived, and the strain of the exposure was so great that he expired on the shore after being rescued. The funeral took place in Milwaukee from his home, and was in charge of the Masonic fraternity, of which he was a member. Mr. Zimmerman was born in Milwaukee on February 6, 1881. His early training was in the grammar and high schools of Milwaukee, where he showed from the beginning an exceptional ability, graduating with high honors. From the public school he went to the University of Wisconsin, where he spent five years, taking the degrees of Bachelor of Science and Electrical Engineer. Here, too, his work was exceptional, and besides taking up a good deal of extra work he was elected to membership in the honorary engineering fraternity of Tau Beta Pi. His thesis on the aluminum electrolytic condenser was the basis for several papers and further work in that line later which attracted a great deal of attention here and abroad. He was graduated in 1903. His first work outside of the University was as an apprentice with the Westinghouse Electric and Manufacturing Company at Pittsburg, where he spent nearly two years. He was transferred to the Nernst Lamp Company, and there again he showed remarkable ability, making several important discoveries and improvements, particularly in glower construction and in the chemistry of the glower. He was next employed by the Carborundum Company of Niagara Falls as metallurgical engineer. In the three years of work there he made decided advances in electric furnace work, and was responsible for some important improvements in the silicon furnace. He decided to go back to the University of Madison to carry on some original work and have at his disposal the laboratory facilities for the analysis of raw materials. In addition to his furnace work at the University he took up the subject of wireless telegraphy and perfected some new detectors that are being used with great success. He invented several improvements for transformers and designed a successful interrupter. He had a fine analytical mind and was able to balance theory and practice in a remarkable way. He was an enthusiastic instructor and his enthusiasm was infectious, his students and colleagues having for him a great admiration and affection. He was a member of the American Electrochemical Society, the American Institute of Electrical Engineers, the American Chemical Society, the American Ceramic Society, the American Association for the Advancement of Science, and the British Society of Chemical Industry. Recently he was elected a member of the honorary fraternity of Sigma Xi. Among the more important papers contributed to technical literature by Mr. Zimmerman were "The Aluminum Electrolytic Condenser," "Some Physical Properties of Silicon," and "Concentric Tubular Conductors for Electric Furnace Feeders." In this issue we print an abstract of the paper on silicon before the American Electrochemical Society. We find it hard to make any expression of the personal loss which we know has been incurred by the members of his family, by the electrical fraternity and by his students, brother instructors and friends in the calling away of Mr. Zimmerman. He was a fine fellow with the cleanest moral sense, and was an ardent worker for high scientific development. His place will be hard to fill.

PERSONAL MENTION.

CHARLES F. MEDBURY has been appointed to succeed H. D. Bayne as manager of the Montreal office of the Canadian Westinghouse Company.

C. L. GOODRUM has been elected second vice-president of the American Automatic Telephone Company. Mr. Goodrum is the inventor of the system which the Automatic Telephone Company is placing on the market.

J. H. DAVIS has been promoted from assistant electrical engineer of the Baltimore & Ohio Railroad, to electrical engineer of that company, with headquarters in Baltimore. Mr. Davis will succeed L. T. Gibbs, whose death occurred some months ago.

DR. A. P. WILLS, adjunct professor of mechanics at Columbia University, has been appointed professor of mathematical physics in that institution, to succeed Prof. Richard T. Maclaurin, who will become head of the Massachusetts Institute of Technology.

S. J. CHAPMAN, who for the last several months has been superintendent of the electric department of the Canton Gas and Electric Company, has resigned. He will continue in the electric business in another city.

FRANK S. WIEMEYER, who has represented the Fort Wayne Electric Works in Iowa and Nebraska for the past five years, with headquarters in Des Moines, Iowa, has resigned his position to handle the "specialties" for the Wesco Supply Company, in the city of St. Louis. Mr. Wiemeyer is well known among the central-station managers from Rock Island, Ill., to Salt Lake, Utah, and his many friends wish him much success in his new field of work, at the same time regret very much to have him leave them.

MR. AND MRS. HENRY AUGUSTUS REED observed the fiftieth anniversary of their marriage last week. At the celebration luncheon there was a host of relatives and a few friends. Mr. Reed was presented with a diamond ring by his children and the mother was presented with a gold belt buckle. Mrs. Reed was presented with a diamond brooch by her husband. There were other numerous and beautiful presents from members of the family and friends. Mr. Reed was eighty years old last February and Mrs. Reed seventy-four years old in April. Mr. Reed was made president of the Bishop Gutta-Percha Company in 1904. He has been connected with the company since 1876.

INDUSTRIAL ITEMS.

THE ROBBINS AND MYERS COMPANY, Springfield, Ohio, announces some interesting literature concerning the minimum cost of operation in the cooling of large areas when its "Standard" oscillating electric fan is selected. Catalogues and booklets can be obtained on request.

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY secured an order for a 125-horsepower Muenzel producer-gas engine and gas-producer plant from the Sisseton Mill and Light Company, Sisseton, S. D. This engine will run both the flour mill and electric-light plant and will be in service twenty-four hours a day.

THE ELECTRO-MECHANICAL ENGINEERING BUREAU has opened offices in the Monadnock Block, Chicago, for consultation, inspection and tests along mechanical, electrical and chemical lines, and will give expert attention to any technical subject, including the development and design of devices, processes and such ideas as may be patented.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has opened an office in Denver, Colo., located in the Ideal Building. This new office is in charge of O. H. Davidson, of the Electric Manufacturers' Sales Company. Mr. Davidson will have charge of the Wagner Company's business in Colorado, New Mexico, Utah, Montana and eastern Idaho.

FRANCIS' McCAFFREY, 107 North Boston Avenue, Atlantic City, N. J., is one of the leading electrical contractors in this section. Mr. McCaffrey started in business in a quiet way April 1, 1905, after a previous experience of eight years in practical lines. A determination to maintain a high quality of work has resulted in the building up of a very successful business.

THE VALENTINE-CLARK COMPANY, Chicago, the well-known dealer in Michigan and Western cedar poles, announces that its plant for the treating of the butts of cedar poles, located at Minnesota Transfer, is now in operation. The company has already made a number of shipments of treated cedar poles to prominent electric-light, power and street-railway companies.

THE OKONITE COMPANY, New York city, has recently changed from an English to a United States corporation, and has been organized under the laws of New Jersey. The following-named gentlemen are the officers of the company: Willard L. Candee, president; H. Durant Cheever, treasurer; George T. Manson, general superintendent; William H. Hodgins, secretary.

The main offices of the company are at 253 Broadway, New York city, and the factories at Passaic, N. J. This company is one of the largest manufacturers of high-grade insulated wire in this country.

THE WASSON REEL COMPANY, Clinton, Ill., is selling a large number of its perfected cable and wire reel. This machine is the result of a careful study of construction difficulties and apparently is a very satisfactory solution of the problem. It is expected that this reel will be on exhibition at the Atlantic City convention of the National Electric Light Association next week.

STUDEBAKER BROTHERS COMPANY, New York, has executed a contract with the H. C. Piercy Company, of New York, for an equipment of commercial electric automobiles to replace its horse-drawn vehicles. The details of the change-over have been under study for a year and the mechanical departments of the Piercy Company will have the guidance and direction of the Studebaker engineers until it is qualified to handle the installation independently.

THE DARLEY ENGINEERING COMPANY, 149 Broadway, New York, announces that since May 12 the Pittsburg office has been abolished, and the engineering, purchasing and sales departments heretofore located there, have been transferred to New York city, where all communications should be sent. The Chicago office will remain in the Monadnock Building. The new officers of the company are as follows: W. A. Stadelman, president and general manager; C. L. Inslee, vice-president; W. G. Hudson, vice-president; W. W. Ricker, treasurer; M. D. Chapman, secretary.

FREDERICK J. DRAKE & CO., Chicago, the well-known publishers of educational books, have recently issued the following electrical works: "Electric Railway Power Stations," by Calvin F. Swingle; "Operators' Wireless Telegraph and Telephone Handbook," by Victor H. Laughter; "Practical Armature and Magnet Winding," by H. C. Horstmann and Victor H. Tousley; "Electric Railway Troubles and How to Find Them," by Paul W. Lowe, and "Elementary Electricity Up to Date," by S. A. Small. The Drake company will be glad to mail catalogue describing the above works to any address.

THE WILMINGTON FIBRE SPECIALTY COMPANY, Wilmington, Del., has just placed on the market a new insulating paper which it has called "Fyberoid." This is especially adapted for armature slot insulation where a thin insulator is required that is tough, smooth, bends well, and is not affected by heat or dampness. The material can be supplied in sheets approximately fifty inches by seventy inches, or in continuous rolls fifty inches wide containing 100 pounds each. The puncture tests range from 0.005 inch, 1,250 volts, to 0.125 inch, 40,000 volts. Samples of this insulation and full information will be furnished upon request.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURG, PA., in Circular No. 1028, gives a great deal of valuable information on rotary converters. A number of excellent illustrations are given, showing numerous installations of these machines. The electrical and mechanical construction is carefully analyzed and the voltage frequency, efficiency, commutation and electrical and magnetic characteristics discussed. The use of transformers and regulators is taken up in detail and the subject of compounding is given prominent attention. The engineering features having to do with installations, starting up and operation come in for careful treatment, and there is a discussion on several methods of arrangement together with illustrations of typical layouts.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., is drawing attention to the "American" instrument sterilizer in a handsomely printed brochure to the trade. The sterilizer is made entirely of aluminum. The body is cast in one piece, consequently there are no seams to come apart. There is no danger of leaking, in fact, trouble of any kind. Not only this, but the aluminum retains its finish and is always sanitary, clean and neat in appearance. Most sterilizers are flimsily constructed of sheet metal with soldered seams. It is equipped complete with aluminum instrument tray, cover, etc.; made for three different heats, the maximum to heat the water quickly, the minimum—one-fourth of the maximum—being sufficient to keep the water boiling. The size noted is designed for the use of surgeons in the office or operating room, and is large enough to take all ordinary instruments.

DATES AHEAD.

National Electric Light Association. Annual convention, Atlantic City, N. J., June 1-4.

Association of Edison Purchasing Agents. Annual convention, Atlantic City, N. J., June 1-4.

Mississippi Electrical Association. Annual convention, Jackson, Miss., June 15.

American Railway Master Mechanics' Association. Annual convention, Atlantic City, N. J., June 16-18.

Canadian Electrical Association. Annual convention, Quebec, Canada, June 16-18.

Master Car Builders' Association. Annual convention, Atlantic City, N. J., June 21-23.

Association of Railway Telegraph Superintendents. Next meeting, Detroit, Mich., June 23.

American Institute of Electrical Engineers. Annual convention, Thousand Islands, N. Y., June 28.

American Institute of Electrical Engineers. Annual convention, Frontenac, N. Y., June 28.

Ohio Electric Light Association. Annual convention, Toledo, July 13-15.

National Electrical Contractors' Association. Annual convention, Toledo, Ohio, July 21-23.

American Street and Interurban Railway Association. Annual convention, Denver, Colo., October 18-22.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) May 18, 1909.

921,661. TROLLEY. Charles Baker, Philadelphia, Pa. Filed October 15, 1908. Has a tube with an elongated slot therein, secured at an angle to the free end of the pole, a harp carrying a trolley wheel, an elongated plunger on the harp extending through the tube with a device fixed on the plunger and located in the slot to limit the rotary movement of the harp, and a coiled spring around the plunger in the tube between an annular shoulder on the plunger and an adjusting ring or nut screwed on the lower end of the tube.

921,665. CONSTRUCTION OF ELECTRIC TRAMWAYS. Samuel G. Bennett, Heath Town, Wolverhampton, England. Filed November 16, 1905. Describes an electric-railway surface-contact system.

921,666. AUTOMATIC SWITCH. Charles H. Bierman, Milwaukee, Wis. Filed December 30, 1908. An automatic electric switch operates upon the reversal of direction of movement of a moving body.

921,671. VIBRATORY MASSAGE APPARATUS. Howard C. Brown, Chicago, Ill. Filed May 23, 1908. An electric vibrator has its armature shaft at an angle to the axis of the field coil.

921,678. SEPARABLE ELECTRIC CONNECTOR. Frank C. De Reamer, Schenectady, N. Y., assignor to General Electric Company. Filed December 7, 1906. Has a base of insulating material, with two recesses in its upper end, containing contact clips, a flanged contact shell surrounding the lower (narrow) cylindrical end, and connected to one of the contact clips, the other clip being connected to a conductor in the radial recess in the lower end of the base.

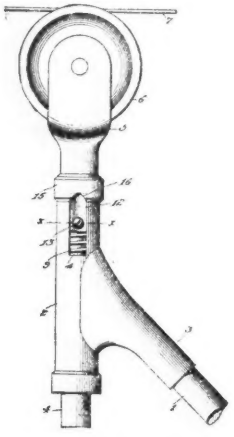
921,693. SYSTEM OF DISTRIBUTION. John L. Hall and Arthur F. Knight, Schenectady, N. Y., assignors to General Electric Company. Filed August 21, 1905. A motor-generator set for regulating the voltage of current supplied through a translating device has the generator element differentially wound, and the motor element compound wound, so as to increase the voltage supplied to the translating device as the current tends to decrease, and vice versa.

921,715. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa. Filed October 10, 1907. Describes a duplex system of telegraphy with a polarized relay for each station connected in a line and with the interposition of retarding devices to the return and means at each station to shunt these devices in accordance with the characters to be transmitted.

921,732. ELECTRIC CUT-OUT. William B. Potter, Schenectady, N. Y., assignor to General Electric Company. Filed January 5, 1905. An electric fuse has three or more integrally connected branches and means for connecting conductor wires to each branch, so that the blowing of any branch will effect the blowing of all the other branches.

921,740. ELECTRIC RAILWAY. William G. Roome, Los Angeles, Cal., assignor to the Union Switch and Signal Company, Swissvale, Pa. Original application filed March 3, 1902. Divided and this application filed December 4, 1902. Describes an electric-railway system divided into block sections, with a track circuit comprising the rails of the track section and including two sources of current and two magnets, and arranged to be a closed circuit when a car is occupying the rails thereof, and a circuit controlled by one of the magnets for preventing the sectional supply conductor of an adjacent track section from being connected in circuit with the feeding conductor.

921,760. ELECTRICALLY-OPERATED VALVE. Isaac G. Waterman, Santa Barbara, Cal. Filed August 28, 1906. Comprises a valve, an electromagnet, an armature controlled by the electromagnet, means for operating the valve from the armature, a slide governing the operation of the valve by the armature, means for shifting the slide from the armature, and an indicator operated by the slide to indicate the position of the valve.



921,661.—TROLLEY.

921,761. ELECTRICAL SWITCH. Isaac G. Waterman, Santa Barbara, Cal. Filed October 6, 1906. Renewed February 27, 1909. There are relatively movable electrical contacts adapted for temporary engagement only, means for causing momentary or temporary engagement of these contacts when they are relatively actuated, and hand-operated actuating means for preventing the contacts from remaining in engagement with each other.

921,768. SYSTEM OF MOTOR CONTROL. Harold E. White, Schenectady, N. Y., assignor to General Electric Company. Filed August 3, 1908. The controller regulates the amount of resistance in the motor circuit, and short-circuits the motor through a resistance for dynamic braking. A master switch controls the switches for forward braking, coasting and power positions, and reverse braking, and a relay energized from the motor circuit completes a maintaining circuit for the switches in the off position of the controller, which will hold the switches in the braking condition for the then existing direction of rotation of the motor, until the motor has come substantially to rest.

921,786. SYSTEM OF ELECTRIC DISTRIBUTION. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed January 7, 1908. A dynamo-electric machine has an armature with a commutator connected to outside wires, two reactance coils connected from different points on the armature to a neutral, the coils being proportioned to change their reactance unequally as the current in the neutral changes.

921,794. POLARIZED MAGNET. Elmer A. Burlingame, San Francisco, Cal., assignor to Burlingame Telegraphing Typewriter Company. Filed July 13, 1908. Magnets with suitable poles are arranged in sets, so that magnets of negative polarity and of positive polarity are in each set, and magnet coils of opposite windings and having suitable soft-iron cores are located between these sets, armature pieces being pivotally supported on these cores and so arranged that each is between pole-pieces of opposite polarity.

921,800. ELECTRIC-LIGHT KEY-SOCKET. William C. Clark, Keewatin, Ontario, Canada. Filed March 30, 1908. Has means whereby the inward and outward movements of a slidable tube successively rotate a contact bar into and out of engagement with the conducting screw base.

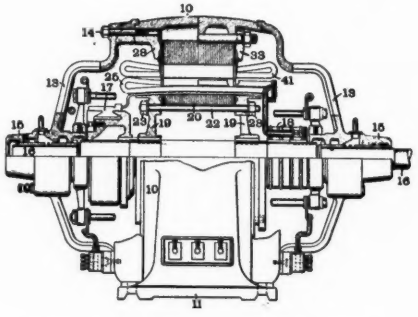
921,808. BATTERY BOX OR TRAY AND HANDLE THEREFOR. Jasper N. Davis, Denver, Colo. Filed July 14, 1908. A battery box comprises a wooden box enclosed within an inner and an outer lead jacket, which jackets are burned together around the upper edge of the box. Hooked lead lugs are burned to the outer jacket, and a handle is composed of alternate layers of lead and rubber, and has solid lead end portions provided with openings which receive the hooked lugs.

921,826. ALTERNATING-CURRENT MOTOR. Winder E. Goldsborough, La Fayette, Ind. Filed August 11, 1903. The armature has armature coils, impedance coils, inductors and short-circuited coils arranged to be a commutator.

921,836. WEATHERPROOF LAMP-SOCKET. Herman T. Hochhausen, Brooklyn, N. Y. Filed July 25, 1907. Describes a form of electric-lamp socket with a shell contact and a central contact.

921,839. KEY-SOCKET SWITCH. Harvey Hubbell, Bridgeport, Conn. Filed December 21, 1908. Describes the details of a form of incandescent-lamp socket switch.

921,845. TUBE-RAILWAY SYSTEM. Elfric W. C. Kearney, Westminster, London, England. Filed January 19, 1909. A single-track subway or tube-railway system has a series of



921,914.—DYNAMO-ELECTRIC MACHINE.

independent single main-track sections connecting the platforms of adjacent stations, each section being provided with two dead ends, two like-handed turnouts connecting the single main-track sections at the respective ends of the platforms at each intermediate station, signals at each turnout, and means for normally locking all facing points in the open position until such time as the crossing trains have both arrived at the stations.

921,866. ARC-LAMP. Berthold Monasch, Berlin, Germany, assignor to General Electric Company. Filed May 8, 1906. Has an electrode pivotally connected to a draft tube, with its arcing surface normally in line with the tube, but adapted to be swung out into such position, and a revoluble cleaning device located at one side of the axis of the tube, and in position to be engaged by the arcing surface when the electrode is moved out of its normal operating position.

921,893. MULTIPLE OPERATION OF VAPOR-ELECTRIC DEVICES. Robert E. Russell, Schenectady, N. Y., assignor to General Electric Company. Filed September 18, 1905. Vapor-electric devices connected in multiple are supplied from a source of alternating current, and equalizing devices are provided in circuit with the direct-current leads of the respective vapor-electric devices, impedances being connected respectively in series with the alternating-current supply circuits.

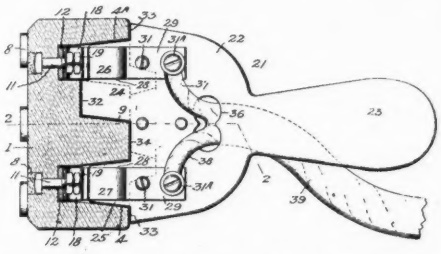
921,894. COMBINED AUTOMATIC SIGNALING AND TELEPHONE SYSTEM. Edgar E. Salisbury, Chicago, Ill., assignor to Signalphone Alarm Company. Filed November 25, 1901. Describes an electric-alarm system for call boxes.

921,914. DYNAMO-ELECTRIC MACHINE. Arthur H. Timmerman, St. Louis, Mo., assignor to Wagner Electric Manufacturing Company, St. Louis, Mo. Filed November 5, 1906. A dynamo-electric machine is provided with an enclosing casing, which has an annular central part, with end caps supporting the rotor.

921,918. SYSTEM OF ELECTRICAL DISTRIBUTION. Matthew O. Troy, Schenectady, N. Y., assignor to General Electric Company. Filed November 11, 1905. There are means for deriving currents of constant value from a source of alternating current; also devices for rectifying both polarity waves of the currents, and means for transmitting the combined currents of the rectifying devices to a return conductor.

921,930. PRODUCING AMPLIFIED CURRENT VARIATIONS. Ezechiel Weintraub, Schenectady, N. Y., and Marius C. A. Latour, Paris, France, assignors to General Electric Company. Filed November 26, 1907. The system described comprises a vapor-electric device, means for maintaining the device in a conductive condition, means for passing current therethrough of a value insufficient to maintain an arc, and means for varying the current.

921,935. INCANDESCENT-LAMP SOCKET. Arthur L. Williams, Waterbury, Conn., assignor of one-half to Charles Doescher, Waterbury, Conn. Filed January 11, 1909. A spring is contracted to permit the cap to be passed over or removed from the top of the shell and interlocked therewith by the spring.



921,959.—ELECTRIC VEHICLE-CHARGING WALL SOCKET AND PLUGS.

921,959. ELECTRIC VEHICLE-CHARGING WALL-SOCKET AND PLUG. Jasper N. Davis, Denver, Colo. Filed March 9, 1908. The plug has projections of unequal width to prevent it from being inserted in the socket in the reversed position.

921,970. ADJUSTABLE SUPPORT FOR DROP-LIGHTS. Peter Frantz, Dixon, Ill., assignor of one-half to Oscar H. Hyde, Springfield, Ohio. Filed September 28, 1907. Has a horizontal spring-actuated drum pivotally supported in an adjustable frame, flexible means for supporting a lamp from this drum and for engaging a pivotally mounted brake lever for the drum.

921,989. AUTOMATIC MOTOR-STARTER. William F. Hendry, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed December 21, 1905. Has an electromagnetically operated switching mechanism for controlling the flow of current to the motor, an electromagnet for restoring this to its initial position, and a circuit for this electromagnet which is automatically closed upon the failure of the motor current supply.

922,001. TELEPHONE. Eugene Koehler, Philadelphia, Pa. Filed January 12, 1909. Has a device for clamping the receiver to a person's body.

922,006. ELECTRICAL SIGNALING SYSTEM. Albion D. T. Libby, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Filed May 12, 1906. A transformer has a secondary winding connected to a signal-receiving device, and two primary windings adapted to produce opposite effects on the transformer core, and means for alternately connecting these windings to a source of a current.

922,014. SIGNALING APPARATUS. John Melvin, Toowoomba, Queensland, Australia. Filed August 6, 1908. Describes a form of illuminated semaphore with electrical connections.

922,024. TROLLEY-SWITCH. Carl P. Nachod, Philadelphia, Pa. Filed October 27, 1908. Consists of a longitudinally extending frame, means for supporting the same in proximity to a contact conductor, and longitudinally extending, resilient, laterally yielding contact-strips supported by the frame and insulated from each other.

922,033. MOVABLE CONTACT FOR ELECTRIC SWITCHES. Johann G. Peterson, Hartford, Conn., assignor to the Arrow Electric Company, Hartford, Conn. Filed January 11, 1909. Has a lower and an upper supporting plates, lugs connecting these, and lugs projecting upwardly from the upper supporting plate, contact plates mounted on the first-mentioned lugs and contact plates extending at right angles to the other contact plates mounted on the lugs projecting from the upper supporting plate.

922,034. PUSH-BUTTON ELECTRIC SWITCH. Johann G. Peterson, Hartford, Conn., assignor to the Arrow Electric Company, Hartford, Conn. Filed February 1, 1909. Has a rocker plate provided with a perforation, and a push button having the shank with a hook and mortise at its end, the hook being shaped to enter freely the perforation when the parts are out of normal operative relation, but to engage and interlock with the plate when the parts are in normal operative relation.

922,045. TELEPHONE PAY-STATION. Thomas H. Roland, Huntington, W. Va., assignor of one-fifth to Abraham Tweel, Huntington, W. Va. Filed August 11, 1908. A non-return device for depositing coins has sets of contacts for signaling circuits which are made and broken by a passing coin.

922,057. REGULATOR FOR ELECTRIC CURRENTS. Thomas Spencer, Philadelphia, Pa. Filed November 25, 1905. Is a form of reactance regulator for alternating-current circuits.

922,079. CELL FOR ELECTROLYTIC OR OTHER PURPOSES. Henry S. Blackmore, Mount Vernon, N. Y. Original application filed April 11, 1906. Divided and this application filed September 24, 1907. Consists of an electrode comprising a metal acetylid and a binder, an opposite electrode, and a body of electrolyte, held in a suitable receptacle.

922,081. ELECTRIC GAS-IGNITER. William D. Brackett, Minneapolis, Minn. Filed March 2, 1908. Has wiping contacts at the free ends of conducting rods.

922,098. ELECTRICAL TRANSMITTING APPARATUS FOR CONTROLLING THE SIGHTING OF GUNS. Arthur T. Dawson and George T. Buckham, Westminster, London, England, assignors to Vickers Sons & Maxim, Limited, Westminster, England. Filed November 20, 1908. A rotary transmitter switch controls an electrically-actuated pointer on a range dial.

922,099. POLARIZED RELAY. Robert L. Dean, Kansas City, Mo., assignor to Dean Rapid Telegraph Company. Filed February 6, 1908. A magnet controls the movement of a pair of superposed tongues vibrating between contact stops, one on each side of each stop.

922,107. BRUSH-RIGGING FOR DYNAMO-ELECTRIC MACHINES. Gano Dunn, East Orange, N. J., assignor to Crocker-Wheeler Company. Filed January 2, 1908. A brush-holder has split parts clamped to the sides of the brush stud outside of the insulation.

922,119. DYNAMO-ELECTRIC MACHINE. John D. Firmin, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. Filed February 19, 1906. A multipolar dynamo has adjustable means independent of the frame for adjustably clamping each coil to its support.

922,123. MACHINE FOR TESTING INCANDESCENT LAMPS. Theodore W. Frech, Jr., Cleveland, Ohio, assignor to National Electric Lamp Company. Filed December 26, 1905. Circuit-closing contacts are located so as to send a current through a lamp in the rotatable head when the head is rotated in one direction, and a current of different voltage when the head is rotated in the opposite direction.

922,172. CONTROLLER-REGULATOR. Charles E. Lord, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed November 30, 1906. A fixed-notched member co-operates with a pawl to stop the forward movement of the controller shaft at predetermined points.

922,192. RELAY. Hugh C. Rice, Denison, Tex., assignor of one-half to Abraham Lincoln Knaur, Denison, Tex. Filed June 5, 1908. Has a sensitive armature for a magnetic member located between the magnetic member and an insensitive armature (for the magnetic member), also a local circuit connected with both armatures and controllable by the joint action of the same.

922,206. COMPOSITE SIGNALING SYSTEM. Henry B. Stone, Providence, R. I. Filed July 20, 1908. Describes a composite signaling system with a telegraph branch and a telephone branch, and a repeating coil operatively associating the telephone branch with the line circuit.

922,218. AUTOMATIC VOLTAGE-REGULATOR. Hermon L. Van Valkenburg, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed July 30, 1906. A solenoid for each of a series of switches, when energized, tends to close the switch, a second solenoid for each switch, when energized, tends to open the switch, and connections are provided whereby each solenoid when energized completes the circuit of a corresponding solenoid of the next switch.

922,219. AUTOMATIC VOLTAGE-REGULATOR. Hermon L. Van Valkenburg, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed July 30, 1906. A modification of the previous.

922,230. COMMUTATOR-TYPE HIGH-SPEED DYNAMO-ELECTRIC MACHINE. Charles J. Yates, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed October 29, 1906. The armature comprises a core and an end clamping member having an outwardly extending flange, and the coils carried by the core have projecting portions surrounded by an end ring, both resting on the flange.

922,245. DYNAMO-ELECTRIC MACHINE. Bernard A. Behrend, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed March 14, 1907. The stator has an enclosing housing provided with a shaft opening, and the rotor is provided with a shaft extending outwardly through this opening. The shaft has a longitudinal slot adjacent to the opening in the housing, with a collector lead in the slot, and surrounding the shaft and lead at the shaft opening in the housing is a sleeve, rotatable with the shaft and insulated from the lead, to retain the lead in position in the slot. A collector ring is provided on the shaft outside of the housing, also means for fastening the extreme end of the collector lead to the ring.

922,300. MEANS FOR PREVENTING THE FLOW OF WATER THROUGH A WATER SYSTEM. Richard G. Lindenberger, New York, N. Y. Filed July 8, 1907. An electromagnetic alarm is actuated by a release device on an automatic valve.

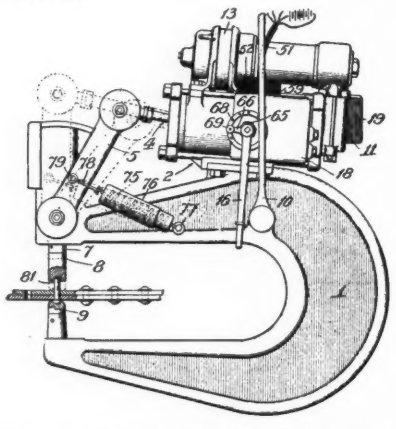
922,309. ELECTRIC-WIRE CONNECTOR. Fred More, Kingston, N. Y. Filed February 25, 1908. Has two walls at right angles, a groove in the inner face of one of the walls, and suitable openings for retaining elements.

922,313. INSULATOR. Louis McCarthy, Boston, Mass., assignor to the Macallen Company. Filed February 14, 1907. Has metallic portions separated by laminated insulation, with its crevices and interstices free from air and moisture and filled with an insulating compound commercially known as ohmlac.

922,320. ELECTRICAL SIGNALING SYSTEM. James G. Nolen, Chicago, Ill., assignor of one-half to Frank B. Cook, Chicago, Ill. Filed February 2, 1903. Is a form of automatic electric fire-alarm system.

922,333. ELECTRICAL WATER-HEATER. Delia B. Rawson, Los Angeles, Cal. Filed July 8, 1907. An electric device heats a continuous stream of water.

922,360. WIRE ATTACHMENT FOR ELECTRICAL DEVICES. Henry Trumbull, Plainville, Conn., assignor to Trumbull Electric Manufacturing Company. Filed October 19, 1905. In combination with an insulating base and a pivoted switch blade mounted thereon are an electric contact mounted on the base, a plate separate from and connected with the contact and extending laterally therefrom (the outer end of the plate being bent upwardly and backwardly so that its free end lies in close proximity to the outer portion of the electric contact to form a stop for the switch blade), and means seated in the upwardly bent portion of the plate for securing the wires thereto.



12,957.—POWER APPLIANCE (REISSUE).

922,377. ELECTRIC ANIMAL-EXTERMINATOR. Byron S. Ames, Williamsport, Pa. Filed July 27, 1908. Consists of a body portion inclined downwardly in all directions from the center and formed in sections, insulated from each other, forming the terminals of an electric circuit, also means for supporting a decoy at the highest part of the body portion.

922,391. ELECTRIC SIGNAL. Pierre I. Chandeysson, St. Louis, Mo., assignor to Peters Signal Company, Knox, Ind. Filed January 25, 1908. A semaphore blade is actuated by the shaft of an electric motor comprising a four-pole armature and a four-pole field.

922,399. ELECTRICAL TRANSMITTING APPARATUS FOR CONTROLLING THE SIGHTING OF GUNS. Arthur T. Dawson and George T. Buckham, Westminster, London, England, assignors to Vickers Sons & Maxim, Limited, Westminster, England. Original application filed November 20, 1908. Divided and this application filed March 20, 1909. Modification of No. 922,098.

922,406. SWITCHING DEVICE FOR ELECTRIC LAMPS. Charles A. Eimer, Los Gatos, Cal. Filed August 3, 1908. The circuit is made or broken by pulling the corresponding one of two depending strings or chains.

922,410. ELECTRIC-LIGHTING SYSTEM. Clarence Feldmann, Delft, Netherlands. Original application filed June 22, 1906. Divided and this application filed May 24, 1907. In combination with an alternating-current generator are iron resistances and choking coils connected up in parallel.

922,436. ELECTRICAL SIGNALING SYSTEM. Ray H. Manson, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Original application filed January 16, 1906. Divided and this application filed April 18, 1907. A transformer has one of its windings connected to a pole changer, which is connected to a source of electric energy, and a second winding connected to signaling leads.

922,443. ELECTRIC SWITCH. Walter Van Patten Steiger, Bridgeport, Conn., assignor to the Perkins Electric Switch Manufacturing Company. Filed November 12, 1908. Has a pivoted contact member, a rock lever pivoted eccentric to the latter, and spring means for operating the former upon the actuation of the latter, a detent adapted to oppose the contact member, and means in connection with the rock lever having its actuating parts arranged at a greater distance from its pivoting point than that of the points at which the actuating force is applied to the lever.

REISSUE.

12,957. POWER APPLIANCE. Morris C. White and Otho C. Duryea, Los Angeles, Cal., assignors to American Gas Tool Company, Phœnix, Ariz. Filed March 1, 1909. Original No. 911,187, dated February 2, 1909. A riveting machine is operated by an explosive charge behind a piston in a cylinder, the charge being electrically ignited and compressed by a pump operated by an electric motor.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired May 25, 1909:

475,289. ELECTRIC ARC LAMP. L. Brianne, Paris, France.

475,335 MANUFACTURE OF ELECTRODES FOR SECONDARY BATTERIES. J. F. McLaughlin, Philadelphia, Pa.

475,340. AUTOMATIC ELECTRIC HEAT ALARM. F. S. Palmer, Boston, Mass.

475,394. INCANDESCENT ELECTRIC LAMP. H. Green, Hartford, Conn.

475,399. ELECTRIC ACTUATOR FOR REGISTERING MECHANISMS. C. F. Holt, New London, Conn.

475,402. PROCESS OF OBTAINING METALLIC ZINC FROM SULPHITE OF ZINC BY ELECTROLYSIS. T. Lange, Brieg, Germany.

475,410. ELECTRIC MECHANISM FOR RECIPROCATING MOTION. H. S. McKay, Boston, Mass.

475,411. ELECTRIC METER. A. G. McKenna, Allegheny, Pa.

475,441. TELEGRAPHIC RELAY. C. Cuttriss, New York, N. Y.

475,467. TROLLEY FOR ELECTRIC RAILWAYS. J. W. Newhouse, Indianapolis, Ind.

475,468. ELECTRICAL TRANSMITTING SYSTEM. F. E. Now, Cleveland, Ohio.

475,491, 475,492 and 475,493. ELECTRIC LOCOMOTIVE, T. A. Edison, Llewellyn Park, N. J.

475,494. ELECTRIC RAILWAY. T. A. Edison, Llewellyn, N. J.

475,514. ELECTRIC CAR-LIGHTING SYSTEM. J. F. McElroy, Albany, N. Y.

475,527. COIN-CONTROLLED ELECTRICAL APPARATUS. H. Wickham, Milwaukee, Wis.

475,538. SYSTEM OF ELECTRIC LIGHTING. M. J. Cowgill, Omaha, Neb.

475,544. ELECTRIC ARC LAMP. R. S. Dobbie, Brooklyn, N. Y.

475,566. AUTOMATIC ELECTRIC TIME CHECK. C. K. Jardine, Georgetown, British Guiana.

475,702. ELECTRIC MOTOR CAR. W. H. Patton, Chicago, Ill.

475,703. ELECTRICALLY HEATED SAND BOX. L. E. Pease, Cambridge, Mass.